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ABSTRACT

This book surveys current commitment to computers in education in many countries, with emphasis on use in Australia. For discussion of computer-related programs, countries other than Australia are categorized as (1) under-developed and uncertain--China, Thailand, and Yugoslavia; (2) developed but reluctant--Japan, Germany, and Sweden; and (3) developed and committed--Norway, France, United Kingdom (including England, Wales, Northern Ireland, and Scotland), United States, and Canada. The situation in Australia is then specifically addressed, with a summary of the status of computers in schools for each state and territory: Victoria, New South Wales, Queensland, Western Australia, South Australia, Tasmania, Northern Territory, and Australian Capital Territory. Developments at the national level in Australia are also examined. A final chapter provides an overview, analysis of non-Australian practices, summaries of non-Australian findings and the Australian position, and 20 recommendations regarding computer uses in Australian schools. A bibliography lists 126 items. (LMM)

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Computers in Education

by L.W. Shears and E.C. Dale

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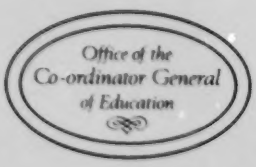

A Report to
The Honourable Robert Fordham M.P.
Minister of Education
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COMPUTERS IN EDUCATION

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L W S
E C D

AUTHORS' STATEMENT

Effective preparation and involvement of teachers is the key to the successful utilisation of computers in education. Solutions relating to hardware and software problems are important for the development of the process but are largely irrelevant for its application if teachers as a whole are not persuaded that the use of the new technology in classrooms and lecture halls will produce better results for pupils and students than the procedures to which they have become accustomed.

L W Shears
E C Dale

CHAPTER ONE

SURVEY OF PRACTICES IN OVERSEAS COUNTRIES

INTRODUCTION

1.1 The use of computers in education is not a practice which is accepted or even considered desirable by the authorities in all the countries which were visited. Obviously some countries are not sufficiently developed economically to introduce computers into education on a large scale. They are also uncertain as to the level of priority which they should give any future introduction. These countries include China, Thailand and Yugoslavia.

1.2 In the developed countries, there is a division of opinion on the use of computers which to us in Australia may appear to be surprising. Japan, Germany and Sweden are developed countries which for reasons which will be explained later have policies of reluctance or opposition to the use of computers in schools. The developed countries which are committed to the large scale introduction of computers into the education process are France, United Kingdom, U.S.A, Canada and to a lesser extent, Norway.

1.3 For the purposes of this survey of overseas practices we have divided the countries into three categories which are "under-developed and uncertain", "developed but reluctant", and "developed and committed".

UNDER-DEVELOPED AND UNCERTAIN - CHINA, THAILAND, YUGOSLAVIA

CHINA

1.4 The predominantly rural culture and economy of present day China and its level of development does not justify the diversion of scarce resources to the introduction of computers in schools for educational or administrative purposes. Further, the educational philosophy in this, as in other Asian countries, places much emphasis on the teacher-pupil relationship as of key importance in learning. The use of computers in schools is not supported because of the expected adverse effect on this relationship. Both teachers and educational administrators have a reactionary attitude to the introduction of mechanical and electronic technology to the classroom, based far less on fear of unemployment of teachers than on their expectation that the teachers' role will be lessened and the learning situation damaged.

1.5 At tertiary level in colleges and universities elective studies in computers are available for familiarisation

purposes. Some specific training courses for professional or career purposes are available but at Nanjing University, one of the largest, the computer centre is still small, providing some instruction in chemistry and mathematics. Extension of computer use at tertiary levels is planned but is unlikely to develop at the school level in the near future.

THAILAND

1.6 The Headquarters of the Education Ministry in Bangkok has a computer centre which is undertaking the second year of a five year project for a Management Information system. It is an administrative application of computer use for student and staff numbers in schools, teacher qualifications, finance and budget considerations and building programmes.

1.7 The Department of General Education in Thailand has also developed proposals for the use of computers in the administration of school information, including timetables and support staff. The main items handled by computer are personnel management, school data, data processing, suppport staff for school administrators, budget and expenditure, civil works and control of educational hardware.(1) There are few computers used in schools for instructional or familiarisation programmes, and the main developments are for administrative use and data storage.

YUGOSLAVIA

1.8 Little development has occurred so far. Some familiarisation programmes are being undertaken in a few schools. One initiative is the development of model centres in which computers are available for familiarisation purposes for students but only a few of these centres have been established.

DEVELOPED BUT RELUCTANT - JAPAN, GERMANY AND SWEDEN

JAPAN

1.9 Educational leaders in Mombusho estimate that only 10% to 20% of Japanese schools have computers and given the world standing of Japan in the microelectronics industry this percentage is surprisingly low.

1.10 The Japanese authorities gave a number of revealing reasons for this situation. First, the availability of cheap, high quality electronic and computer equipment in all areas of

Japanese society is high. Children are brought up in an electronically geared society and have access to sophisticated equipment in the form of calculators, personal computers and video equipment. The electronic industry has become an integral part of Japanese life, and the structured and formal introduction of children to computer awareness programmes is not seen as necessary. The existence of and opportunity for hands-on experience with computers is taken for granted.

1.11 Second, it was argued that motivation was not a serious problem in Japanese schools and the use of computers which they appeared to regard as a "teaching gimmick" was unnecessary. The intensely competitive nature of schooling with its strict allocation of rewards according to performance in examinations covering a limited curriculum was considered sufficient motivation.

1.12 Third, and linked with motivation is the relative lack of discipline problems in schools, the dominance of family ties and loyalty within the community and the responsiveness of students to those loyalties through effort and performance at school.

1.13 Fourth, Japanese companies do not want schools to teach computer applications, preferring to work on the familiarity students already have by means of application programmes which are tailored to meet their needs. These vary from company to company.

1.14 Despite the general trend, some upper secondary schools are conducting trials in the use of computers in education for instructional use particularly in mathematics. In each of the 47 prefectures in Japan, large Teacher Training Centres with good residential facilities have established centres for computer education for teachers of vocational engineering courses. Science and mathematics equipment grants through the Ministry enable the prefectures to allocate funds for the purchase of computer equipment by local schools if thought necessary.

1.15 The Ministry of Education (Mombusho) has computer facilities for payroll, personnel and buildings data and the overall development of the administrative use of computers is comparable to that in the Victorian Ministry of Education.

GERMANY

1.16 Germany also accepts the philosophy that the teacher-pupil relationship is of great importance and that the unplanned or premature introduction of computers may be detrimental to this relationship by partly replacing the teacher with a machine. As is the case in Japan, the availability of resources for the purchase of computers in schools and the associated software is not the issue. Traditional attitudes to teaching and syllabuses in most of Germany are not seen as compatible with the large scale introduction of computers into the learning environment.

North Rhine-Westphalia

1.17 There is not a great deal of support for the use of computers in schools for either familiarisation or instructional use at secondary level (10-16 year olds). Only 5-7% of children have any direct experience with computers in schools(2), and the majority of schools are not making a serious attempt to provide it.

1.18 However, North Rhine-Westphalia has a private computer company (Nixdorf) making computers for schools and offering vocational training in computer education in a school run by the company. This company has recently set up a joint venture with New Zealand with a 50% equity.

1.19 The universities conduct the majority of their computer programmes as Information Science courses and these courses do have a significant influence on the upper secondary school curricula. The German Research Society advises the government on university requirements for computer facilities and the advice is forwarded to the States, which are responsible for administering the universities. The Society keeps a register of computer facilities in universities.

Bavaria

1.20 Since 1976, steps have been taken to introduce a project of providing computers for upper secondary levels, (gymnasium and vocational colleges) at the rate of 50 schools per year. Initially, the Ministry of Education provided four terminals for pupils in each of 400 schools at upper secondary level, at a cost of 14,000 DM per school (about $5,000 to $6,000). The local community was expected to provide additional material such as software and

training opportunities from whatever sources were available. The provision of computer facilities is proceeding steadily but cautiously. (3,4,5)

1.21 Universities in Bavaria use computers for Information Science courses and very extensively for research. Munich University and the Technical University of Munich share an IBM Computer for research and administrative purposes costing $20 million. The Insitute of Higher Education uses the IBM computer which is within the Ministry of Education. The Bavarian Ministry of Education uses its IBM to deal with administrative data such as personnel records, teacher qualifications and teachers' examinations.

Hamburg

1.22 School programmes involving computers are very limited but they are offered as electives in the gymnasia for those who want formal training to Abitur (Year 12) level.

SWEDEN

1.23 Computers are generally confined to the upper secondary schools (Years 10-12) and specific use is made of these in subjects such as science, chemistry and economics. Inservice training for teachers is available and it includes topics such as the effects of computers on society. The administrative use of computers in schools is being planned and a programme is expected to be underway by the end of 1984.

DEVELOPED AND COMMITTED -NORWAY, FRANCE, U.K., U.S.A., CANADA

NORWAY

1.24 Norway has recently established a small Computer Unit in Oslo and the staff is enthusiastic about the use of computers. However, the use of computers in education is still relatively undeveloped. Twenty-five to thirty percent of comprehensive schools use them, high schools to a far lesser extent. The Norwegian Television and Broadcasting Commission has plans for a new ten hour course for teaching with computers in primary and secondary schools.

1.25 Depending on the expertise available, some regional colleges have Computer Science studies. The comment was made that, because of the cost, it is always an opposition political party which strongly supports the widespread introduction of computers.

1.26 There is as yet no large scale computer installation for administrative use, but planning is under way for the use of a large computer to deal with personnel and other data. Some research work has also been done to provide guidelines for the counties (regions) on the use of computers in educational administration.

FRANCE

General Policy

1.27 France is by far the most advanced of the European countries in the application of computers in all areas of familiarisation, instruction and the administration of education. The national emphasis is on the need to develop high technology to an advanced degree for the country to advance. Computers are considered essential for a complete general education at high school level, and both familiarisation and instructional progammes are seen to be complementary and necessary.

1.28 A most significant feature of the French approach is acceptance of the fact that the teacher is the central factor in the success or otherwise of the use of computers in education, particularly in the school.

Developments: 1970-1978

1.29 On the initiative of the Centre for Educational Research and Innovation, in 1969 Professor W. Mercouroff of the National Ministry of Education was nominated Chargé de Mission a l'Informatique at the University for Education for introducing Computer Science in secondary education. The emphasis was to be on courseware which was based on simulation and model building, rather than on Skinnerian learning or the acquisition of technical skills such as programming. The underlying philosophy, developed by a group of educators including Jacques Hebenstreit, Head of the Computer Science Department, Ecole Supériere d'Electricité was based on the reduction of learning time by the use of teaching models which were extended to make knowledge coherent and operational.(6)

1.30 A large scale trial programme to introduce computers into secondary schools began in 1970, with the aim of placing a minicomputer with 8 consoles attached into each of 58 high schools by 1976. The emphasis on teacher training found expression in the programme through which five hundred teachers were trained over a six-year period by training units established at universities at Nancy, Toulouse,

Grenoble, St Cloud and Reims. Two kinds of training were introduced: full time for one year, and training by correspondence including a few days of hands on experience. Two languages, BASIC and LSE (symbolic language for teaching) were used.

1.31 Due to lack of funds the programme received little assistance between 1976 and 1979. The main outcome was the training of 3,000 teachers, 500 during each full academic year, the others by correspondence and the development and use of over 400 courseware packages.

1.32 There were however, certain problems outlined by Hebenstreit (6) which provide a cautionary note for us in the development of our approach to the use of computers in schools.

"despite official instructions there were an important number of packages using programmed learning (mainly in French grammar or foreign languages)"
"during the one-year full-time training, too much emphasis was put on computer structure and programming per se, and not enough on the pedagogical use of computers and this has produced some harmful results; for instance a non-negligible number of teachers have been fascinated by the machine and have become unconditional 'computer-niks' supporting the idea that it is important to teach computer science as a separate discipline (the probable reason behind this attitude is that it is more fun to play around with computers than to teach algebra or history); another harmful result comes from the fact that many teachers had great difficulties in mastering the use of a programming language and had therefore a tendency to consider that the challenging part in a courseware package was the writing of the programme and not the definition of the pedagogical objectives. The net result are some packages of little real value because their objectives are trivial or could be achieved with pencil and paper or in book form"
"despite the fact that almost all teachers realised that producing a package was a difficult and time-consuming activity, many of them had a very critical attitude towards packages written by others (the not-made-here syndrome)".

Developments Since 1979

1.33 The experimental work begun in 1970 and discontinued in 1976 was recommenced in 1979. In the new programme the use of computers as a tool for teachers and for familiarisation purposes for students is being emphasised. The policy is to regard the computer as a standard component of classroom aids in all subjects.(10,11,12)

1.34 To resolve the problem of training the teachers, four universities have each established a training unit in which specialists train teacher-instructors to a high level of expertise. Twenty-five specialists are available to assist in this task.

1.35 Training for teachers of all subjects is provided also in eleven centres spread throughout France. The training is undertaken during school terms. The teacher-trainers who have undergone this training take part in the training of their colleagues who come from schools equipped with computers. For each High School so equipped, an instructor (teacher-trainer) from the regional team is given responsibility for training in the establishment. Together with the school administration, the Instructor organises training courses for teacher volunteers from the school (including the clerical staff) on the following bases:

- Preliminary information is provided for the teacher volunteers
- The total period of the learning module is 80-100 hours
- The module is split into several sessions spread out in time, each session for several consecutive days with a minimum of two days. This spread can be done, for example, in four sessions of three days
- The instructor responsible monitors the results in the High School during the school year
- A follow up session of several days is possible during the following school year.
- As a general rule, the instructor takes part in all the programmes in the schools for which he is responsible. A second instructor takes part each time with him. As far as possible, their original teaching subjects are different.
- The whole of the programme for a High School is conducted on the broad base of a credit of nine weeks of training, 5 weeks for the preparation and carrying out of the training by the responsible instructor; 4 weeks for the participation of the second instructor.(11)

1.36 At the conclusion of their training, the teacher volunteers must be sufficiently familiar with their micro-computers to:

- set the system in working order
- introduce the pupils to the practical use of the computer and of its peripherals
- use, in their classes, the programmes of the national library or from local sources
- write and adapt minor programmes requiring on the rudiments of an evolved language (LSE)
- express, under the supervision of qualified persons, tasks in the form of draft programmes.(11)

Teachers with particular interests are then able to follow up their training to develop greater mastery over the equipment. The aim in a school is to develop a multi-disciplinary team of such teachers. Such a team might develop a scheme and plan how to carry it through to a conclusion. They may submit a project to the regional director concerning development of a programme. They might even submit a project at the national level to the Director of Secondary Education, or concerning educational research to the National Centre for Education Research.(8,9)

1.37 Standardisation of equipment is regarded as important for rapid development of expertise and an appropriate tender is accepted by the Ministry for the purchase of computers after the needs of schools have been ascertained by teachers and computer advisers. Funding is assisted by an allocation from a 1% tax levy on industry for vocational training purposes. Despite the standardisation efforts, in practice there appears to be a range of equipment in use, some of which is not well supported by software.(7)

1.38 By the end of June 1983 it is expected that 400 of the 1200 high schools will have computers, and that the older models will be replaced by the mid-1980s. There are currently about 120 programmes available for schools involving approximately 400 hours of teaching. The programmes have been prepared by trained teachers, and the same personnel are used for the conduct of inservice education courses.(11,12)

1.39 Certain problems have arisen in the development of teaching with computers. The vast majority of the assisting courseware packages give direct assistance to the student. These packages are designed to be used by the student

sitting alone in front of the terminal. Most of them have the objective of teaching something to the student and very few are of the simulation type (exploring micro-worlds). Such packages transfer the teacher/student relationship to the computer/student relationship. Hebenstreit (6) has criticised these procedures:

"In the same line of thought most of the existing packages do not allow any freedom to the student. He is not allowed to browse through a lesson before starting as he normally does with a book to get a feeling of what it looks like; he is not allowed to skip some questions without answering; he is not allowed to ask for an increase or a decrease of the level of difficulty at any moment inside a lesson; he is not allowed to stop a lesson at a given moment, take another one and then come back where he left the first one. He is in fact the 'prisoner' of the current learning track where the only freedom he has is to go on or to quit. From the user's point of view, the user is under the control of the computer and this should not be allowed for deontological reasons."

"In any situation, and mainly in education, computers should always be programmed so as to behave like 'slaves' or 'robots' where the initiative is always with the user and never with the computer. Courseware packages should be designed so as to transfer the role of the teacher not to the computer, but to the student; the computer being used as a tool or as a resource and not as a knowledgeable master. No computer should be allowed to judge humans and therefore no computer should ever be allowed to print 'You are wrong', because that sentence is a judgement".

1.40 Some primary schools have also begun to use computers, using LOGO language which is useful for graphics and familiarisation programmes.

1.41 The introduction of the computer as an administrative and library cataloguing device has begun but is not yet extensive.

1.42 In the tertiary sector 84 of the 4000 colleges have begun a programme for which each college has been allocated an ensemble of 6 microcomputers and a printer.

1.43 Of the 1350 lycées, 350 are currently being equipped for computer education. Full technical training is available on a part-time basis over two to three years. A serious shortage of suitably trained personnel still exists at the technician level. Shortages also exist in the professional

engineering area and new sections of the technical high schools are being equipped with computers to prepare students adequately for university training in the engineering fields.

UNITED KINGDOM (England, Wales, Northern Ireland)

1.44 While interested groups and individuals have been pressing the claim of computers in education for over a decade, the dominant programme now for England, Wales and Northern Ireland is the Microelectronics Education Programme (MEP) initiated by the Department of Education and Science in conjunction with the Department of Industry. It was announced by the British Government in March 1980 as a four year programme to commence in 1981 with an allocation of funds of £ 9m. The MEP has now been extended for a further three years for 1984-1986 and has been promised another £ 10m. The intention is ultimately to involve all 7000 secondary schools and 27,000 primary schools for a population of 55 million people.

1.45 The aim of the Programme is "to help schools to prepare children for life in a society in which devices and systems based on microelectronics are commonplace and pervasive. These technologies are likely to alter the relationships between one individual and another and between individuals and their work; and people will need to be aware that the speed of change is accelerating and that their future careers may well include many retraining stages as they adjust to new technological developments". (17)

In the development of the Programme's strategy, it was assumed that schools would be encouraged to respond to technological and societal changes by amending the content and approach of individual subjects, that methods of teaching and learning should make use of microcomputers and other related equipment, that use of the microcomputer would develop the capacity for independent learning and information retrieval, and that the new devices would be used to assist the learning of children with physical or mental handicaps. (14,15,17)

1.46 The scope of the Programme was concerned initially with the application of microelectronics in schools and in non-vocational courses for 16-19 year olds including GCE-O and A level courses and pre-vocational courses. The Programme has now extended to primary schools and its impact at secondary level has been far more wide ranging than was originally anticipated. (13)

The Government allocated funds of £ 9m in 1980 to implement the Programme. In addition, the Department of Industry agreed to subsidise the purchase of equipment on a 1 for 2 basis. Support for regional teacher training activities is one third of the total allocation of £ 9m. The remaining two thirds is expended equally between curriculum development and software development and resources combined. Staffing costs are a major part of this expenditure. Theinterest shown in the Programme generated some redirection of resources in the regions, with the result that there were significant additional funds spent on the Programme from within each region.

1.47 The Department of Industry supported the purchase of two kinds of microprocessors by means of their subsidy. These were the BBC Microcomputer from ACORN Computers which could be bought for around £ 280 with a £ 130 subsidy and a more sophisticated model known as Research Machines 380Z, which could be bought for around £ 1700 with a subsidy of £ 840. The Sinclair Spectrum was approved for use in schools but was not subsidised.(16)

1.48 A most significant government condition for obtaining financial support for the purchase of equipment from the Department of Industry was that two teachers from any school applying for a subsidy were to undertake a suitable programme of in-service training.(16) The training of teachers, together with the implementation of the whole MEP project was organised through 14 regions set up for the purpose from the existing 109 Local Education Authorities (14,15).

1.49 The in-service courses were divided into four domains: computer awareness, computer based learning, communications and information systems (e.g. retrieval) and electronics and control technology (programming).(17) The courses were broadly at three levels: short courses of 1-3 days in residential regional centres, more intensive courses of up to one week, and specialist courses in particular fields of up to three months. MEP funds contributed to the salary costs of the in-service tutors and teaching materials. Travelling and out-of-pocket expenses of teachers were also met by the Programme.

1.50 Some universities, colleges, teacher centres and schools were also offering in-service training before the MEP began and were encouraged to continue. In-service training of the required kind in teacher training institutions was implemented as a result of discussions and experiences stemming from the in-service training programmes.(17) Liaison with the national providers of open learning systems assisted many with access to training programmes.

1.51 The thrust of the MEP was to infiltrate the whole school curriculum with the use of computers in education, not merely to add on subjects and topics. The link between teacher training and curriculum development was therefore vital. The MEP sponsored the production of two kinds of teaching and learning materials:

- Those in which microcomputers were used to assist with traditional subjects, priority being given to applications in mathematics, sciences, craft/design technology, geography and courses related to business;

- Those which introduced microcomputer topics in the curriculum, including: microelectronics in control technology, applications of electronics, computer studies, computer linked studies (computer aided design, data processing), word processing, and use of computers in information retrieval.

The materials were to be developed at a national, regional or local level. Some subject associations were already in the process of preparing software packages and groups of schools or neighbouring LEAs were encouraged to develop materials. The MEP undertook to support a limited number of curriculum projects developed by national organisations, projects generally involving LEA co-operation across boundaries, i.e. from regional curriculum development groups, and a number of small projects undertaken by teachers. The regionally developed materials were given the most support. The costs of materials, travel and field trials were met by the Programme and the salary costs of many project teams.

1.52 The support services providing information and resources were based on LEA advisory services already in existence and a network of pilot information centres servicing groups of not less than four LEAs were established with the responsibility of providing and exchanging information on hardware, software and other materials. Priority for the wholeProgramme was given to the setting up of these pilot regional information centres.

1.53 The MEP was to promote different methods of software distribution, and define standards in programme languages, documentation and equipment specifications. A glossary of terminology for participants in the Programme was also developed. Sets of materials and software were also able to be purchased by schools at low cost.(17) This provided some income for the Programme and placed more perceived value on the materials than if they were issued free.

1.54 From the initial aim of introducing one microcomputer into every secondary school, the MEP has now succeeded beyond its expectations and is working its way through the primary school system. Local and parental support has been very high and the extension of the Programme for another three years indicates its acceptance by schools and the community. The use of information systems (videotex) linked with the television transmitters CEEFAX (BBC) and ORACLE (ITV) or the telephone lines (PRESTEL) have assisted the public both with learning about the MEP and through it has generated interest in computers.(13)

1.55 Problems which have not yet been fully overcome by the MEP include the attitudes of some teachers who do not wish to participate in computer education, lack of funds to develop software libraries, shortage of suitable staff, insufficient demonstration equipment in teachers' centres, and despite the fact that most secondary schools average four microcomputers, there is insufficient equipment in schools for ready hands-on experience. The quality of software is dependent on the people available. A combination of curriculum specialists working with programmers has produced better quality software than teachers working alone. Links with the tertiary sector are not sufficient to provide all the computer expertise necessary for training teachers nor to provide consistency between courses to streamline the curriculum for students at the secondary and tertiary level. In addition equipment used in schools has not always been available in the tertiary institutions offering training courses, and it might have been desirable to make equipment available for teacher training before placing so much of it in schools.(13)

UNITED KINGDOM (Scotland)

1.56 In 1979 the Scottish Education Department began a programme which is now referred to as Phase 1 of the Scottish Microelectronics Development Programme (SMDP).(23) Educational establishments were invited to submit proposals for microelectronics projects under which hardware would be supplied to the school or college. The programme had £ 320,000 available but was heavily oversubscribed with bids totalling over £ 2,000,000 being received. This overwhelming response resulted in many worthwhile projects not being supported and many other receiving less than had been originally requested. These SMDP projects covered almost all subjects taught in schools and colleges, from the expected mathematics, science and engineering through to important applications in geography, home economics,

farm management, business studies and careers guidance. Several projects explored uses in remedial and special education, including applications for deaf and for blind children. Other projects concentrated on educational management and administration.

1.57 Sixty-eight projects were developed, some involving more than one establishment.(23) The project centres are distributed throughout Scotland, from the Orkneys in the north to the border country in the south, and from the island of Skye in the west to Aberdeen in the east. Through this programme, SMDP established centres for educational software development and for investigating the possible effects of microelectronics in various subject areas.

1.58 A national hardware and software centre was established at the SMDP base in Glasgow. It contains most of the microcomputer systems in use in schools and colleges and is available for use by educationists and industrialists.

1.59 In April 1980 the Scottish Minister responsible for Industry and Education, Mr Alex Fletcher, MP, announced in Parliamentthe establishment of a £ 1,000,000 research and development programme over 4 years as an extension of the original Phase 1 initiative. This programme is now known as Phase 2 of SMDP.(22,25,26) The SMDP staff includes a Director, Deputy Director, Executive Co-ordinator and Information Officer and will have up to 10 programmers with technical and secretarial support. The steering group for the Programme consists of representatives of Scottish Education Department, the Convention of Scottish Local Authorities (COSLA) and the Scottish Council for Educational Technology (SCET). An independent evaluator from the Department of Education, University of Edinburgh, has also been appointed. The Programme makes extensive use of advisers and consultants. It is expected that most of the original 68 projects will continue to be supported in Phase 2 and some additional projects have been selected.

1.60 The emphasis of Phase 2 is on the development of educational software. A software library is being set up on a two-tier basis.(21) Anyone at a school or college can send in rough materials for software which are catalogued at the Glasgow Centre. In 1982 there were 3000 pieces of software in this category. It is vast in quantity, difficult to handle and not guaranteed by the SMDP. The lower level is called contributed or "donated" software. The upper level is called "supported" software and is mostly developed by the Centre. By early 1983 they had prepared 53 "supported" programmes and are aiming to produce about 50 programmes a year.(24) The areas covered

include business studies, physics, mathematics, geography and home economics. They are for teachers to use with pupils and for teachers in training programmes to show other teachers how to use the materials in schools. This is a further example of a country using a combination of pre-service and in-service programmes for teachers.

1.61 The Glasgow Centre is looking to establish links for software exchange with other parts of the United Kingdom and partly to this end it publishes quarterly an SMDP periodical newsletter called "Phase Two"(25,26). The publication provides detailed information about SMDP with regular profiles of individual projects, news of developments in hardware and software and a calendar of forthcoming events.

1.62 The aims and objectives of SMDP have been clearly stated(23) and include the following:

- The promotion within SMDP Phase 1 and Phase 2 centres of general awareness of the implications of microelectronics among pupils, students and staff;
- the production of materials and the provision of practical experience within SMDP Phase 1 and Phase 2 centres for those who will conduct teachers' pre-service and in-service courses in the application of microelectronics in various subjects;
- the use of microcomputers in a curriculum context within SMDP Phase 1 and Phase 2 centres for learning and for assessment purposes;
- the production of curriculum materials within SMDP Phase 1 and Phase 2 centres to enable pupils/students to learn about and gain experience in the use of microcomputers;
- the exploitation of microelectronics within SMDP Phase 1 and Phase 2 centres to assist pupils/students with special educational needs, particularly those suffering from sensory loss;
- the application of microcomputers to management in school and post-school education within SMDP Phase 1 and Phase 2 centres;
- the application of microcomputers to community education and for general awareness in association with the Scottish Community Education Council;
- the development of ways and means of promoting joint industry and education microelectronic projects in

association with the Microelectronics Educational Development Centre at Paisley College of Technology;

- the development of a central software and information service in association with selected colleges and regional authorities; and

- the dissemination, collection and exchange of information with other agencies and projects in the U.K. and abroad.

1.63 The main problem with the Programme so far relates to the appropriate training of teachers, particularly older ones who have not had contact with computers in their pre-service teacher training. The administrators admit a problem with the lukewarm attitude of many of these teachers towards the use of computers.

1.64 A second problem is quality control of software. The large quantity of "donated" software, over 3,000 items now available, create handling and dissemination problems, and the quality is often uneven and the material not widely applicable to schools other than where the programmes were developed.

UNITED STATES OF AMERICA

1.65 In the U.S.A. the contact of the public over many decades with the microcomputer technology and insistent sales campaigns have resulted in community pressure for schools to utilise these new techniques. There is a widespread acceptance by parents that computers will help their children. This results in sustained external pressure in contrast to many previous teaching devices which were largely internally devised and without such pressure gathered dust in cupboards and vanished from the educational scene.

1.66 Nearly all schools have computers the most common being the Apple, but many other brands are also available. Unlike the United Kingdom, there has been no co-ordinated introduction of computers in schools and while there is a considerable amount of random enthusiasm and effort, evaluation of the benefits is difficult. Despite this approach, administrators are aware of the need to be critical about the quality of software programmes, andalso to train teachers in handling computers as part of their general training activities. The sources of software are now being monitored and attempts made to control the quality of small scale material produced without the backing of the large publishers and educational suppliers.

1.67 It is not possible to cover the range and scope of development in computers in education in the U.S.A. The following sections merely illustrate two computer developments which have become known internationally in education. The methods they have devised to meet problems as they arose are worthy of study.

The Computer Curriculum Corporation, California

1.68 At Stanford University, Palo Alto, California, a Computer Curriculum Corporation (CCC) was founded in 1967 as an outgrowth of educational research at the Institute for Mathematics Studies in the Social Sciences (IMSSS). Pilot computer aided instruction projects began in 1972 by the Director of IMSSS, Dr Patrick Suppes, were successful and led to the establishment of the Computer Curriculum Corporation as a means of providing expertise in high quality CAI curriculum development to hardware manufacturers interested in offering CAI as a product.

1.69 By 1977, as a result of research and development CCC was able to offer a system specifically designed for CAI and including hardware, software, curricula, training, maintenance, and educational consultation. (27,28) General purpose computer manufacturers are considered not to have the understanding of the educational concerns and environment to provide the support needed for effective administration of the CAI. Thus, CCC claims to have become a leader in the integration of the needs of both the academic and industrial communities.

1.70 Another recognised aspect of the educational market is the need for high-quality equipment at the lowest possible per student cost. By 1977, the CCC development of techniques for optimising the hardware and software components for delivery of CAI combined with a manufacturing facility for supplying and packaging components, resulted in the development of the CCC-17 Instructional System which supports 96 student terminals on a minicomputer ordinarily expected to support only 8 users.

1.71 By 1982 CCC was offering an educational package (30,31) where each student had a complete microcomputer serving not only for delivery of CAI in support of the conventional school curriculum, but also providing the student with an individual computing environment for learning computer technology and exploring the uses of computers in solving problems.

1.72 CCC claims that its ability to compete successfully in this variety of environments is attributed to its continuing potential for attracting and retaining highly qualified

professional and technical personnel who combine an expertise in their own field, whether it be hardware or software, with a strong interest in the application of computer technology to education.

1.73 The stated high quality of the curricula results from the internal staff of curriculum authors who combine subject matter expertise with a background in education for appropriate selection of instructional methodology and presentation. CCC provides authors with training in an authoring language and the fundamentals of programming for effective development of courses. A separate staff of programmers is also available for assistance in development of exercise formats and curriculum. The evaluation department provides the results of course monitoring and evaluation.

1.74 The introduction in 1981 of the Digital Speech System (DSS), designed and manufactured by CCC, has also been in response to a problem area in CAI. Beginning readers can now receive audio instructions rather than reading their instructions. The DSS is also used for the new English as a Second Language (ESL) curriculum. Improving English language skills is viewed by Suppes and his team as a significant step toward helping bilingual students achieve maximum benefit from all their CAI courses.

1.75 The Education Testing Service (ETS) at Princeton University, New Jersey, conducted in 1982 an independent study known as the ETC/LAUSD study (29) of the effectiveness of the CCC programmes as applied to four elementary schools over a period of four years. The curriculum CAI programmes provided by CCC covered drill and practice in mathematics, reading and language arts. The mathematics programme was given to Grades 1-6, and language arts and reading to Grades 3-6. Each curriculum was designed to reinforce skills which students had already taught in the classroom. The study produced the following findings:

- With only 10 minutes per day of mathematics CAI, students made significant gains in their computation skills compared to control students.
- With 20 minutes of mathematics CAI, students doubled gains in computational skills.
- During a second and third year of mathematics CAI, students increased their gains significantly.
- Smaller but consistently positive results were obtained in the first year of reading and language skills with 10 minutes of CAI daily.

- Reading and language skills were maintained - but not increased - with additional years of CAI.
- The benefits from mathematics CAI were about equivalent to the benefits from equal amounts (in minutes) of individual tutoring.
- As used in this study, one 10 minute session of CAI daily throughout the school year was estimated to cost US$130.

The study also found that while there was some initial resistance to CAI by teachers, this was overcome by the end of the first full year of operation and not only most teachers but also parents and the majority of students accepted CAI.

The Plato System (Programmed Logic for Automated Teaching Operations)

1.76 The PLATO system of computer education runs on the large CYBER mainframe computers from the Control Data Corporation in the U.S.A. The system can handle hundreds of terminals and connect to other mainframes, minicomputers and microcomputers to build a giant network system. PLATO courseware includes a number of uses such as the Tutor authoring system, learning management (CML) programmes, substantial courseware libraries, specialised services such as speech synthesisers, data processing facilities, microcomputerised video tape control and information processing through satellite beams and microwave links for distance education.

1.77 The keyboards for learning programmes are designed to reduce the amount of memory work for user codes so that young children can learn to use the keyboard quickly. Novel devices such as touch sensitive screens, and very high resolution screens (512 x 512 dots as compared to an Apple which has 320 x 240 dots) make graphics and information response visually precise and easy to handle.

1.78 The educational programmes are mainly concerned with computer-aided instruction levels of sophistication based on behavioural objectives and reinforcement learning. Advocates of this learning style claim significant improvement in mastery of skills and concepts by students from junior levels to university standard study. Sacramento State University, (107) one of the 19 campuses of California State University and with over 23,000 students, has a large PLATO installation which is used for a range of educational goals including distance education,

management of student instruction (CML), various administrative purposes and community education broadcast system. It is shortly to be connected to a cable television network which will allow greater flexibility of operation, particularly for distance education students. The university defends its multi million dollar investment on a number of grounds particularly the 'robustness' of the system. Poor endurance and service problems with small scale, cheaper equipment are seen as demonstrating false economy and inadequate learning resources.

1.79 The University of Delaware (104) also has a PLATO system and uses it, inter alia, for a sophisticated music theory course for undergraduate students. The programme includes a music synthesiser and enables chords and musical combinations to be synthesised and analysed on video screen. The programme took 7 years to develop at a cost of US$3.5m. Fifty programmers worked on the courseware, a brainchild of the leader of the course, Dr F. Hofstetter, who admits that the course needs to be offered for a considerable period of time to a reasonable number of students before the investment is cost effective. Because this course deals with basic components of theory, the programme is unlikely to become redundant. The man hours required to produce programmes of this type indicate a need for long term assessment of their likely value before engaging on their development.

CANADA

1.80 The educational computing community in Canada is at present attempting to form a national organisation with which all present provincial organisations will be affiliated without loss of autonomy. According to some commentators, (56) educational computing in Canada suffers from a general lack of communication between relevant authorities, duplication of effort and under-funding of research projects. Over the past nine years, as a stop-gap measure, the Canadian National Research Council Associate Committee on Instructional Technology has functioned on a limited basis in the role of cross-province co-ordinator but is restricted by its mandate and its own lack of funding. The provinces have varied markedly one to the other in the degree of their development and implementation of computers in education. (38,56)

British Columbia

1.81 Ten years ago, the government of British Columbia was spending three million dollars yearly on computers in education. Computer Science was taught at the secondary and post-secondary level, using both batch and interactive processing off main frame computers located in major centres throughout the province. The increase in the number of microcomputers during the seventies resulted in a conglomeration of PET Commodore, TANDY TRS-80 and Apple computers in use, with little central co-ordination or support facilities.(56)

1.82 Three years ago, the British Columbian government contracted with a private research company, JEM Research, (49) to develop microcomputer based instructional and in-service materials for a pilot group of seven of the seventy-one British Columbia School divisions. The research company nominated the Apple II as their recommended equipment and attempted to make one thousand subsidised systems operational throughout the pilot divisions. The research company encountered many obstacles both in their pilot projects and throughout the province. The choice of Apple alienated established users of other systems, since little support was available for them. The research company ultimately was unable to fulfil its initial contract. No new software was developed but existing materials were re-written to meet British Columbian standards. Five hundred dollar incentive grants to teachers produced no software of usable quality and additional money was constantly sought to support even the meagre services available in the pilot divisions. (44) The project budget was cut back to one third of its original figure, with the government gradually phasing out an unsuccessful attempt to have private enterprise assume a role normally played by an educational authority.

1.83 British Columbia has been active in other areas of research into computer education. One project is that undertaken by the Computer Users in Education of British Columbia. (CUEBEC). CUEBEC received funding recently to conduct a study on the implementation of a microcomputer network for educational institutions in the province. The CUEBEC mandate has been to explore networking options. Success has been claimed in most areas. With the increase in microcomputer technology, the Education Department of British Columbia established communication among teachers as a major priority and further to this objective has encouraged the CUEBEC networking research.

Ontario

1.84 The Ministry of Education in Ontario has issued several statements on principles relating to the use of computers in schools on the basis of the province's Computers in Education Project, which has been operative for several years. (46,48,54,55,59,60,61) The Minister of Education, Dr Bette Stephenson stated in 1982 that it was intended that every child should have access to microcomputers and become familiar with computer language. At present all secondary schools and about 30% of elementary schools have microcomputers mainly favouring PET Commodore (90%) Apple and Tandy TRS-80 models. In 1981 there were well over 3000 microcomputers in Ontario schools which had an enrolment of 1.8 million students.

1.85 A report of November 1982 (41) from the Ontario Ministry of Education on existing policies and future directions outlines their commitment. Computers are seen as intellectual amplifiers (45) for children and computer literacy as a key aspect of general education. Present policy acknowledges the impact of computers in education; the need to extend Ministry approval procedures, so far limited to textbooks, to computer based learning materials; the need to develop centralised cataloguing and indexing systems for learning materials; financial support to ensure compatability of equipment conforming to agreed criteria; and general support for high-technological innovations including the development of interactive videodiscs and the use of TV Ontario, the educational communications authority. (64,65) Guidelines for modifications of the centrally devised intermediate and senior level school studies are being revised and a computer literacy statement for all teachers, students and parents will be disseminated in 1983.

1.86 Teacher training at both familiarisation and specialist levels is strongly supported for all staff at pre-service and in-service levels, although the emphasis is on familiarisation, curriculum and instructional use rather than on programming expertise. (49) An organisation entitled "TV Ontario Academy on Computers in Education" (65) has been established. It provides a 12 week course able to be taken at home and is in the form of 12 half-hour television programmes. The aims of the self-help learning system are to assist teachers and others to become familiar with the workings of the computer, to develop simple programmes to understand basic microelectronics terminology and to evaluate and select software for the classroom. A package of written materials accompanies the course. The Educational Computing Centre Organisation of Ontario, (ECCO), organises conferences and conducts workshops for

its fifteen hundred members, as well as assisting policy makers in determining the computing needs of teachers. Currently, ECCO is concerned with the establishment of a policy governing the control and direction of educational computing in Ontario. (40)

1.87 A long range plan, "A Planning Report on Educational Computing in the 80's" (1982-1990) is being considered by senior officials (41). Eleven strands make up the main body of the report including Literacy, Implications of Microprocessors on Curriculum, Training, Public Information, Lessonware/Courseware, Cataloguing and Indexing of Computer-Based Learning Materials, Dissemination of Courseware, Hardware Implications, Recommended Administrative Structures, Research and Funding.

1.88 TV Ontario is a publicly owned provincial television network dedicated to providing educational programmes to the public. (57,64,65,66) It has established a two way information system incorporating both the sending and receiving of information known as Telidon. Telidon is a teletext and videotex system claimed to be the most sophisticated in the world. It comprises encoded text and graphics delivered to the television screen by a broadcast signal. Videotex, delivered by telephone or other connection to a TV screen allows viewers to interact with a number of complex data bases of pages of information. The information can be stored in a memory and displayed after the original source has been disconnected. Telidon is used as an educational medium by providing the user with information at his or her own pace, periodic feedback and tests and display graphics on a range of topics. Successful field trials on Telidon were conducted from 1979 to 1981 in association with the Federal Department of Communications, Ontario educational institutions, and community groups.

1.89 The Educational Computing Network of Ontario (ECNO) (47) is managed by the Ontario Ministry of Education on behalf of the province. The network's objective is to deliver effective data-processing services to educational communities in the province through the commonality of equipment and software developments. The main advantage claimed for membership of the network is the equal access by all members to the computing facilities necessary to support school administrative functions, despite the broad geographical distribution of participants. The members of the network also effect savings by having centrally defined computer services which include software packages, training programmes for new users, co-operative data sharing, regular seminars to keep members up-to-date, and support services from Ministry staff.

Saskatchewan

1.90 A feature of the development of computers in education in Saskatchewan lies in the total reliance within that province on the services of the crown corporation SASKCOMP, the Saskatchewan computer facility. (56) All educational research and government administrative services are co-ordinated through SASKCOMP on a province-wide basis, involving a sophisticated system of extensive networking.

1.91 In education the emphasis has been on a policy of computer literacy for every student by the eighth year of study. A level-by-level curriculum has been developed and implemented in an effort to meet the requirements outlined in policy. Computer facilities are used also in the area of computer managed instruction and testing. Through the extensive use of consultants in computer education and the direction of the very strong users' group, the Saskatchewan Association for Computers in Education (SACE) this province claims to have made computing a well-established part of the education of all students in their school system.

Manitoba

1.92 After a number of attempts in the 1970s to establish a computer policy which were unsuccessful due largely to changes in government, the task was taken in hand again in 1982. A task force (56) composed of people with expertise in computer technology as well as generalists from all areas of education was established. This task force was assigned the following responsibilities:-

- assessing the need for and feasibility of introducing computer literacy into the K-12 school curriculum
- identifying the goals and the target population for the introduction of computer literacy K-12
- establishing the broad objectives reasonable for student achievement at the various grade levels
- determining methodology, time requirements, equipment and teacher training required to fulfil the objectives
- delineating the areas and degree of probable costs to be incurred in achieving the goal.

The task force presented a Manitoba model (56) for a computer awareness curriculum. Included within this model are recommendations for a broadly based dollar-for-dollar support for computer technology in those schools following

the prescribed curriculum; the development and implementation of the role of a school co-ordinator of educational computing; and the establishment of province wide consultant services to co-ordinate the establishment, maintenance and service of computer technology.

1.93 Manitoba teachers accept that computing is here to stay and are competing for the available space in in-service sessions most of which are provided by the Department of Education.

Alberta

1.94 Educators in Alberta are firmly in favour of computer education throughout the school system beginning at elementary school. The rationale for such computer literacy is based on the transformation of industrial society due to the use of the computer and the subsequent creation of what the people of Alberta regard as the greatest occupational upheaval in history. This upheaval requires new and more trained skills. However, newspapers report regularly on the high unemployment rate attributed largely to the introduction of computers in business and industry, and the creation of the techno-peasant with insufficient skills who is unable to find employment. (43) The result is a Janus-like duality where computer education is seen as critical for future generations while increased introduction of the computer is progressively reducing the opportunity for employment at unskilled levels. The need of the future generation to acquire the skills necessary for employment and survival is the basic reason for acceptance of computer education for all in Alberta.

1.95 In Alberta the computer literacy programme (32,35,36,37) is based on the following assumptions

- All students should become computer literate.
- Students should gradually be exposed to all dimensions of computer literacy: awareness, function and critical understanding.
- Since computers affect all subject areas, computer literacy should not be considered as the specialisation of one subject or group of educators. Interdisciplinary content and examples from various subject fields should be incorporated into the programme.

- The computer literacy programme should promote a greater understanding and increased utilisation of computer technology in other subject areas.

- Some of the objectives of the computer literacy programme can be achieved only through hands-on computer experience for each student. (62)

1.96 The Alberta Education Computer Committee (AECC) of the Education Department has in relation to computer literacy accepted Brumbaugh's (33,37) statement that

"To be computer literate one must be able to describe, demonstrate and/or discuss (critically) how computers are used; how computers do their work; how computers are programmed; how to use a computer and how computers affect our society."

and Goddard's (33,44) important injunction that

"Computer literacy should not be considered the specialization of one subject or one group of educators. An interdisciplinary approach should incorporate elements of computer literacy at all levels and in all subjects where computer knowledge may appropriately enhance the programme."

The AECC recognises three dimensions of computer literacy: awareness, function and critical understanding. It claims that all dimensions should be addressed at each level, elementary, junior high, senior high, but introduced to students in a manner relevant to their abilities. (32,33,35,36) At the elementary level, emphasis should be on the overall awareness of computers in society and their applications to everyday life. The emphasis at the junior high school level should be fostering a functional working knowledge of computers and their capabilities for problem solving. At the senior high level, the programme should stress critical understanding of the implications and effect of computers and how they affect the individual.

1.97 In-service education for teachers is currently conducted by the Education Department with a team of six full time and some part time people. The in-service education is conducted at the request of local districts.

1.98 Procedures for evaluating software have been developed by the Alberta Education Department and are based on evaluation of software discs in terms of the program content, instructional design and technical design. (34) The evaluation procedures include an appraisal of the

objectives of the programme, content, support materials, instructional technique, user interaction, feedback techniques, and student testing procedures.

General

1.99 The Canadian scene reflects some of the problems that arise from a commitment to and an enthusiasm for an educational initiative without having adequate funds, planning strategies or stable policies independent of changes of government to be able to implement it systematically. The differences in approach between the provinces are largely to be expected. The smaller provinces have attempted to introduce computers on a modest but centrally controlled scale. The larger provinces have demonstrated a variety of uneven attempts to introduce computers over a period of years. Ontario and Alberta have been the most successful in establishing a pattern for the longer term use of computers in education. What remains unresolved is the relationship of the use of computers in education and the sociological implications of computers in general. This problem is a source of preoccupation to Canadians. Despite these problems the increasing use of available high technology in Alberta and Ontario for the purposes of consolidating and improving the use of computers in education (62,63) has placed these provinces well ahead of Australian States.

CHAPTER TWO

AUSTRALIA

INTRODUCTION

2.1 The situation in Australia is complicated by the existence of seven states, the Australian Capital Territory and the Commonwealth Government who have achieved varying degrees of readiness or unreadiness for the development of computers in education. There is no doubt that Australian parents and politicians are committed to the utilisation of computers in schools and educational institutions. Whether teachers are as equally committed is uncertain, and the policies and procedures laid down will ultimately determine the level of their acceptance and involvement and subsequently the success or otherwise of the new techniques.

2.2 There is no doubt that Australia is not as advanced in policy development as the other committed countries. It is therefore difficult to describe accurately the present situation. Descriptions of current practices and policies will soon change. However, it is possible to recognise common problems and to outline principles which should apply in future development.

2.3 Although we can present in summary the position in each State and Territory regarding schools, it is difficult to present systematically the tertiary education developments. Where they have been available to us they have been included under the heading of the appropriate State or Territory.

VICTORIA

The 1982 Survey

2.4 In 1982 a survey(84) was undertaken by the Office of the Co-ordinator General of Education of all tertiary and post secondary institutions (through the Victorian Post Secondary Commission and the TAFE Board) and of government schools (through the teaching divisions of the Education Department). The survey sought information on:

- kinds of computer equipment being used
- the provision of familiarisation or computer awareness programmes
- the provision of instructional (curriculum) programmes using computers

- pre-service and in-service training for teachers.
- the provision of courses for careers in the computer field (programming information science).
- the use of computers for administration purposes (student records, library cataloguing, audits).

Primary Schools

2.5 At the time of the survey only a few primary schools had computers, but growing interest was reported due to the extensive publicity in the media on the need to become familiar with computers. The equipment used was generally Apple or Tandy TRS80. Computers were beginning to be developed as a learning aid for handicapped children, but there was a lack of trained staff and suitable software. In primary schools, teaching games and simulation for the purposes of familiarisation were the more common uses, with a few schools using computers also for mathematics at upper primary levels. While the Education Department encourages primary schools to use computers, there was, in May 1982, no clear educational policy on how they should be used, and much of the impetus to buy computers was coming from the school community.

Post Primary Schools

2.6 Most high schools have at least one computer. At the time of the survey (May 1982) the average was 1.4 computers per school. Since then the figure has risen significantly.

2.7 At the upper level of high schools, programmes ranged from familiarisation to subject applications and programming, and in some schools, clubs and extra curricular activities were actively encouraged. Word processing and Computer Studies were included in some schools at Year 11, and Mathematics options at Year 12. A range of equipment existed in high schools, and although the Education Department's Secondary Computer Education Committee endorsed a specified range of equipment, there was nevertheless considerable flexibility of choice for schools. Apple ranked high in popularity, partly because of its low cost.

2.8 Year 12 studies under the Victorian Institute of Secondary Education (VISE) include Computer Science, which is accepted by some tertiary institutions for entry to tertiary studies.

2.9 Technical schools had their choice limited to either Micromation or Option II if they wished to have support from the late Technical Schools Division. More than half the State's Technical schools had these computers. Computer Awareness courses devised by the Technical Schools Division Curriculum Studies Committee were available to technical teachers for use with Years 9 to 12.

Tertiary Sector

2.10 In the tertiary sector familiarisation programmes were available in nearly all advanced colleges. Three of the four universities offered familiarisation courses, the University of Melbourne being the exception. TAFE (Technical and Further Education) colleges offered short courses, based on local demand.

2.11 Instructional programmes in computer education were included in awards at degree and diploma level. For example, components of data processing, computer science and information systems were available in degrees and diplomas in colleges with technology departments and in the universities. Instructional programs at sub-professional and skilled levels were available in a number of TAFE colleges. PLATO was available to them through RMIT. The Victorian Post Secondary Education Commission is at present involved in a detailed study of equipment in use in tertiary institutions.

2.12 Various types of career training in computers were available at colleges and universities at degree, diploma and graduate diploma level. Formal awards in Engineering, Business Studies, Applied Sciences, Commerce and Computer Science were available at selected institutions for professional careers in the computer field. TAFE Colleges offered middle-level courses with computer content - Certificates of Business Studies, Applied Science and Technology were available which include programming, word processing and other vocational applications of computers.

In-Service

2.13 Initiatives for in-service training were generated by the Education Department's primary and secondary and technical school computer education committees. There were also voluntary teacher groups (user groups) which assisted members to become skilled with particular kinds of equipment e.g. Tandy or Apple, and prepare software for specific subjects or topics. The emphasis on school-based curricula in high schools placed a considerable degree of responsibility on the schools and the teachers for developing the use of computers in schools and for

servicing the need for local in-service education. For technical schools, in-service education was initiated both locally and centrally. Limited funds were provided for in-service training on a selective basis by the Victorian In-Service Education Committee (VISEC) for teachers in primary, secondary and technical schools and for some teachers in non-government schools.

Training for Teachers - Pre-Service

2.14 So far, pre-service training in computers for teachers is limited. Melbourne and Victoria Colleges of Advanced Education offer Bachelor of Education courses with specialisation in computer sciences. Graduate diplomas are also available at those colleges and at Monash University.

Administration

2.15 The use of computers for administrative purposes in schools is small but growing. The main uses are for student records and managing the timetable. Very few libraries are computerised, despite the claims of enormous saving of time and increase in efficiency which they bring. Reasons for slow development in areas such as library use include initial costs of setting up the computerised cataloguing and lending systems, and human factors such as anxiety about loss of jobs.

2.16 The central administration of the Education Department has a large Burroughs mainframe computer and ICL equipment used for personnel data, salaries and administrative matters. The mainframe links to the 12 Regional Offices of the Department.

2.17 Many tertiary institutions, in particular the universities and larger colleges have well established and sophisticated equipment for administrative, financial and research use.

Present and Future Developments

2.18 In February 1983, a Computers in Education Task Force was set up by the Education Department to assist in the expansion of the use of computers in education in all types of State schools. The Task Force grew out of the very active and enthusiastic policy groups which had been known as the Secondary Computer Education Committee and the Technical Schools Division Computer Studies Curriculum Committee (86). The Task Force is a unit of six teachers who are based in the South Central Regional Office of the Department. Activities undertaken by the Task Force include an in-service seeding exercise which trains

consultants in computer education with a view to widening the effectiveness of the current programme. So far about 40 consultants have been given three days in-service training which is regarded as insufficient. The Task Force also deliberates on issues arising from curriculum committees which include problems of software development, maintenance and review. It also offers advice to teachers and schools at their request. In March 1983, a Curriculum Committee on Computers in Education was set up by the Education Department. It covers the areas of primary, secondary and technical education (P-12) and its charter includes the following items:

- to identify, monitor and clarify teacher, school and student needs and interests in this area of learning.
- to monitor parent and community concerns in this area of learning.
- to respond to teacher/school requests in terms of policy and operational support.
- to advise on curriculum principles and the development of guidelines for this area of learning within statewide policy.
- to provide in-service education for teachers, school councils and parents.
- to advise on teacher training requirements, resources, facilities and supplies and arrange for the production and dissemination of appropriate curriculum materials for this area of learning.
- to advise on policies and priorities for programmes and research projects, to contribute advice during the development process and to monitor final production and implementation.
- to maintain and further develop liaison and communication networks with other curriculum committees and with various other bodies and agencies of relevance to this area of learning.
- to encourage local participation (schools, parents and community teachers and students) in the development of curriculum according to locally perceived needs.

More recently in July 1983, a Computer Education Advisory Committee to the Director General consisting of senior staff and external experts on computers has been established. This Committee will make recommendations on

policy to the Director General and act in a co-ordinating capacity for other activities and developments relating to the use of computers in schools. The Director-General has announced that the Victorian policy on computers in schools will follow the report of the Commonwealth Schools Commission National Advisory Committee on Computers in Schools.

NEW SOUTH WALES

Policy Statements

2.19 The material on New South Wales is derived from a position paper "Computer Education in N.S.W. Government Schools", prepared in April 1983(72) and supported by discussions held with senior officers in May 1983.

2.20 A Computers in Schools Policy Committee was established early in 1982 with representatives of relevant parts of the Department, chaired by the Director of Studies. This Committee drafted a K-12 Policy Statement on Computer Education.(70)

2.21 In October 1982, the Minister of Education issued a press release and a general guideline statement on computers and computing in education (71) covering all sectors of public education, but with greatest details on the needs of primary and secondary schools. It is a general policy statement setting out the priorities to be addressed. It was also released as a consultative document. Copies were sent to all government schools and to organisations and individuals known to be interested in the topic. Various comments have been received by the Minister.

2.22 The guideline statement and an attachment to it set out the various kinds of uses of and teaching about computers that are relevant, across the whole curriculum, as well as the priorities seen as appropriate. These include Computer Awareness, Computing Studies, the inclusion of Computer-Assisted Learning in various forms and at all levels of education, and uses in support of information and general curriculum functions.

Curriculum Development

2.23 Computer courses of various kinds have been given in N.S.W. schools for over a decade. Most of the activities in recent years, however, have been dependent upon the interest and enthusiasm of individual teachers and the support of principals. In addition, there has been growing interest in computer-assisted learning (CAL) in its various

forms. This has been the case both at the secondary level and increasingly in the last year or two at the primary and infants levels. This has resulted from the availability of microcomputers at a cost which schools can afford and of software designed specifically for school use, together with increased awareness on the part of teachers of the potential of CAL.

2.24 The Secondary Schools Board decided early in 1982 that Computer Education should be afforded a high priority in the total curriculum of Years 7-10, and established an Advisory Group on Computer Education. This Group reported in late 1982, and recommended that Computer Awareness should be a compulsory part of the core curriculum in the compulsory years of schooling, i.e. in Years 7-9. It also recommended the inclusion of optional courses in Computing Studies in the School Certificate. The Board has decided to establish a syllabus committee to develop these syllabuses, by September 1983, for optional implementation in 1985.

2.25 The Department has also decided to establish, and is in the process of setting up, a Curriculum Project Team for Computer Education, K-12, as one of the priority areas for State-wide curriculum development. Like other similar teams, this will have wide terms of reference, will develop K-12 statements, will provide a vehicle for curriculum development for government schools, and will work in liaison with the statutory study boards, and informally with the non-government sector.

Professional Development of Teachers

2.26 There has been a considerable growth in the number of in-service activities related to computing, and assistance with these has been an important function of the initial curriculum consultant in Computer Education. The Directorate of Studies has conducted State workshops to develop teaching methods and software. From these have come useful support materials and resources, including three sets of curriculum support materials for Computer Education published by the Directorate of Studies.

2.27 The State Development Committee funded a residential conference in 1982 of the Computer Education Group (N.S.W.) and a proposal is being submitted for a further conference of the Group in August 1983. The C.E.G. was established in late 1979 and comprises teachers in government and non-government schools interested in computer education, together with academics and administrators. It is making a valuable contribution to the professional development of teachers, and held a conference on computers in primary

education in October 1982, which was attended by a very large number of teachers. A loose-knit National Committee for Computer Education was formed in late 1982, comprising representatives of the C.E.G. (N.S.W.) and similar groups in other States and Territories, together with the Convener of the National Education Committee of the Australian Computer Society.

2.28 Most in-service activities are regionally based, and hence the number of courses and participants is not precisely known, but there has been a considerable growth in the number and variety of courses offered. In addition, there have been many grants for staff development within and between schools.

2.29 In addition to the need for the provision of in-service opportunities in computer eduction, the expected growth poses considerable demands upon universities and colleges of advanced eduction to provide both pre-service and graduate level training. Several CAEs are now offering or planning to offer Graduate Diploma (P.G.1) courses of various kinds in Computer Education, notably the University of Wollongong (Institute of Education), Riverina CAE, Northern Rivers CAE and Mitchell CAE. Department staff have been extensively involved in college advisory committees and Higher Education Board assessment committees.

Computer Equipment

2.30 Since 1979 the Department has arranged with the Government Stores Department for N.S.W. Government contracts for the purchase of microcomputers and associated peripheral equipment for schools. Maintenance and repair of computer equipment purchased under these contracts has been carried out by the Government Stores Department, Technical Services Branch, at no cost to schools as part of the maintenance service funded by the Department of Education.

2.31 The contract issued in 1982 provided for two models of microcomputer, the Apple II of which there are many models now installed and the MicroBee, a new model which is developed and produced in N.S.W. and is available at a reasonable price. The specifications for the microcomputer contract for 1983/1984 have been sent by the Director-General to the Government Stores Department, and tenders are expected to be called by the State Contracts Control Board very shortly. Government schools may obtain microcomputer equipment through the Annual Requisitions Scheme, under which Principals have freedom to select equipment and materials up to their approved allocation.

2.32 In addition many schools have obtained microcomputer equipment with assistance from Parents and Citizens Associations or through special fund-raising activities. Some have obtained computers with funds made available through the Disadvantaged Schools and Country Areas Programmes or the previous Innovations Programme of the Commonwealth Schools Commission.

2.33 Figures on the number of computers in schools are now being collected. A survey in 1982 revealed that 78% of high schools had at least one computer and many primary schools were purchasing their first computer. The number of microcomputers, especially in primary schools, could now be significantly higher. A total figure of 3,000 microcomputers in N.S.W. government primary and secondary schools would be an informed estimate.

Resource Materials

2.34 Computer education requires, in addition to suitably trained and experienced teachers and adequate suitable equipment, both software materials (programmes of various kinds) and curriculum and support materials. These needs exist for all kinds of computer education, whether computer awareness, computing studies or the various kinds of computer assisted learning. Such materials have been in limited supply until recently, and many of those available have been of indifferent quality. There has been a rapid increase in the materials available, not all of high quality, from various sources - public domain software including materials developed by teachers in N.S.W. and elsewhere, proprietary software available for purchase from the vendors of the equipment and third party software developed for sale by specialist software houses and publishers.

The Future

2.35 The Director-General has approved the establishment within the Education Department of a Computer Education Unit, within the Division of Services. This will provide a number of experts with complementary skills, will be a visible focus for computer education activities and innovation, and will provide support to the work in schools and regions. It will work on curriculum development; the evaluation, development and distribution of software and other resource materials; consultancy, support and in-service education of teachers; and give advice on the selection of computer equipment for schools. This will help avoid unnecessary duplication of effort and provide a much more effective basis for support to secondary and primary schools throughout the State. The

unit will be located at a suitable site in the inner metropolitan area accessible to teachers, and will have in addition to the four professional staff already located in Head Office, a senior and experienced leader and support staff.

QUEENSLAND

System Level Activities

2.36 The material on Queensland is derived from a Queensland Education Department position paper prepared in October 1982(76) and supported by discussions held with senior officers in May 1983.

2.37 The initiatives occurring in the Division of Primary Education, the Division of Secondary Education and the Division of Special Education operate through the individual Directors of those divisions and are co-ordinated through the Assistant Director-General of Education (Schools). These initiatives are supported by internal departmental funds and resources and also by some external special funds and grants.

2.38 The Division of Planning and Services operates a 'contract system' which enables particular computer hardware configurations to be recommended as suitable for use in schools. The Divisions of Primary Education, Secondary Education and Special Education are represented on the committee established for the purpose of making such recommendations. This division also initiates activities through its Curriculum Branch and Library and Resource Services Branch. The 'contract system' requires the development of a policy on formats which will be recommended. This is reviewed annually. The recommended microcomputers for 1982 were Apple II, Ohio and Tandy. 16-bit microcomputers and mini-computers are not included in the contract system but schools may request to buy outside recommended items.

2.39 As far back as 1975 a need was recognised for some form of policy regarding the use of computers in education. The Computer Policy Advisory Committee on Education (CPACE) was established in March 1975. It is a policy advisory committee and the acceptance of its reports does not indicate the determination of policy. The CPACE report dated November 1979 recommended that an officer responsible for computing education be appointed to co-ordinate these activities. This committee has been deliberating issues regarding the need for a more formal co-ordinating agency within the Department for Computing in schools; the need

for a review of computing activities in the primary and secondary schools; and the requirements for pre-service and in-service training. The Committee has recently presented its second report to the Director General for his consideration.

2.40 A computer sub-committee of the Departmental Standing In-service Committee has produced a report recommending priorities for in-service education for secondary teachers. This report addresses the need for the training of regional computer consultants, computer administration, in-service education for school administrators and teacher librarians, training subject specialists to become catalysts in their own areas, and assisting teachers develop skills to translate ideas and designs for software into reality.

2.41 The Division of Special Education has established a Special Education Computer Assisted Learning committee charged with the responsibility of monitoring activities and making recommendations in relation to the use of microcomputers and microcomputer software in a small network of participating schools. In addition the Division has supported the purchase and evaluation of microcomputer software and has commissioned the design, development and/or adaptation of microcomputer software materials particularly tailored to the needs of special schools.

2.42 Resources are provided at many different locations within the system. Some examples are:

- A team of four officers in the Curriculum Branch is investigating curriculum applications, developing software standards specifications, providing sample curriculum software, reviewing available software, and developing curriculum guidelines for teachers in the cases of computer awareness and computing studies.

- A team of officers in Library and Resource Services provides information to schools regarding hardware, operating system software and information retrieval software.

- The Division of Secondary Education has provided all State secondary schools with a selection of resources to assist develop a computer awareness programme at the Year 8-10 level as well as print resources to raise teacher consciousness.

- Minicomputers have been established in four educational regions for processing cards sent in by schools and a small pool of microcomputers is available for borrowing and development work.

- Funding is available to schools for purchase of hardware and software from Divisional Contingency funds and from Special Programme funds such as the Secondary Transition Education Project, the Priority Country Area Programme, and Special Schools Programme. Many schools have purchased microcomputers through Parents and Citizens Association funds.

- Management Services Section provides information to schools about the management of microcomputers in schools.

School Level Activities

2.43 The CPACE committee drafted a brief statement in 1977 on the essential elements of and time-lines for a computer awareness programme in secondary schools. However, it remains a school's decision to implement such a programme and hence often depends on access to computing facilities and the availability of suitable personnel. A report of a survey of secondary schools in March 1982 states that 7% of schools with computers operate a computer awarenes programme at the Year 8-10 levels. There is little formal computer awareness activity at the primary or special schools level, but a rapidly growing awareness of teachers means that many individual teachers are providing experiences of this kind for their students.

2.44 All schools with computer facilities are using computers for teaching purposes. Some of these schools are using them in a wide range of subject areas. The Board of Secondary School Studies incorporates in its syllabuses, where relevant, sections and units which refer to computers. For example computers in mathematics, commercial studies, man and computers, art and accounting-data processing. A four semester course in Computer Studies for Year 11/12 is also currently being developed. A great many schools are developing their own software at a growing level of sophistication. A document produced by the Curriculum Branch explores the area of simulation in computer software and its implication for teaching methodology and classroom requirements. Most schools are finding it necessary to explore methodologies involving using one computer with a group of students or a teacher and computer with a whole class situation.

2.45 Some schools at both the primary and secondary level are developing administration support software. Some commercial data bases have also been adapted for school use. The major area of use is for class lists, addresses, moderation, ASAT rank orders, Special Subject Assessment, sports lists and subject option lists. In this area, the Division of Secondary Education has commissioned and trialled a programme collecting information on staffing from schools using an Apple microcomputer system with information being transmitted on data disks sent through the post. This is operating in 1983.

The Future

2.46 The present concerns are to develop mechanisms and procedures through which the effective use of computers can be promoted. These procedures will necessarily include

- investigating the curriculum implications of computer assisted learning and computer aided instruction
- providing advice to teachers on software and hardware evaluation and effective, teaching methodologies using computers
- providing teachers with access to quality software to meet curriculum, administration and information retrieval needs
- monitoring and encouraging existing teacher initiatives in software development through complementary central system and school level activities
- providing continuing support and encouragement for establishing computer awareness and computer studies courses in schools
- providing schools with information regarding a range of hardware configurationsfrom which they may choose
- investigating the role of local information sharing networks, and
- considering on-going in-service education requirements.

2.47 The overall concern of the Queensland Department of Education is that, in a time of rapid technological change, informed decisions are made which ensure that Departmental

support is co-ordinated across all levels (central, regional and school) and is provided by the most appropriate body and in areas where the impact is likely to be immediate and lasting. They are convinced that the creation of a central computer unit incorporating the functions of policy creation, advice, curriculum investigation and software production is the best solution.

WESTERN AUSTRALIA

Policy Statements

2.48 The material on Western Australia is derived from a position paper "Use of Computers in Schools" of October 1982(94) and supported by discussions held with senior officers in May 1983.

2.49 Since the late 1960s the Education Department of W.A. has steadily increased the level of support given to the use of computers in schools. Currently policy-level responsibility for the area rests with the Director of Educational Services and day-to-day management responsibility with the Superintendent of Education (Schools Computing). The Education Department's policies on the uses of computers in schools are contained in two policy statements from the Director-General. One deals with Computing in Secondary Schools (92) and the other with Computers in Primary Schools (93). They were published in 1980 and 1981 and are well known in schools.

System Resources

2.50 There is a Schools Computing Branch which consists of a Superintendent, 6 full-time professional educational staff and 4 full-time technical staff. These officers provide schools with advice and assistance on hardware, software and pedagogic matters. They prepare and distribute computer software, teaching materials and curriculum guidelines. They also plan and run a wide range of in-service activities for teachers and school administrators. The staff is located at the Schools Computing Centre which is the focus for the services provided to schools. The Centre houses the main computers used by schools that have dial-up facilities. It is also the distribution centre for software and the main venue for Schools Computing In-service activities.

2.51 A policy has been adopted to standardise the computing equipment approved for purchase by Government schools. The Schools Computing Branch establishes detailed performance specifications and these are used to survey the computer

market enabling the systems which best meet the educational needs of schools to be chosen on the basis of fair and open competition. Recognising the dynamic nature of computer technology, the Department is committed to regular reviews of its standards. At present, the Applied Technology MicroBee and the Acorn BBC are the approved microcomputers for use in government secondary schools.

2.52 Direct financial assistance is available to schools wishing to purchase approved equipment. They may apply for a dollar-for-dollar subsidy up to a limit of $3,000 per annum (in the case of secondary schools) or $2,000 per annum (in the case of primary schools). No subsidy is available for non-approved equipment. Free maintenance is available on all approved computer equipment acquired by schools anywhere in Western Australia. The service is provided by the Public Works Department and paid for by the Education Department.

2.53 The Education Department is strongly committed to supporting approved systems with the provision of good quality educational software. Resources are allocated to the Schools Computing Branch to provide for the development of specialised applications software. Software produced in this way is made available to Government schools in Western Australia free of charge except for a small charge to cover the cost of the magnetic medium where applicable. In the case of commercially available software, the Department has been quite successful in negotiating bulk purchase arrangements which have resulted in substantial savings to schools using approved equipment.

2.54 A substantial number and range of in-service courses are offered. Some 600 teachers have been involved in courses in each of 1981 and 1982, in some cases with teacher replacement being provided.

2.55 A time-sharing computer network is offered to schools located within the Perth local call zone, and for those country schools which do not have their own computer facilities the Education Department has a 'fleet' of seven portable microcomputers available for loan. Both of these services are provided free of charge.

School Level Activities

Teaching About Computers

2.56 The major emphasis is being directed towards students in Years 8-10, with the intention of providing computer awareness and computer education courses for all students at these levels. A comprehensive set of courses aimed at teaching about computers is being developed and implemented. Currently approximately 80% of secondary schools are providing a computing option subject in Years 9 and 10. In addition, approximately 40% of secondary schools are mounting some form of Computer Awareness course as part of the core programme being provided in Year 8. For upper secondary students a Certificate of Secondary Education course, General Computing, is being offered to Year 11 and 12 students in fourteen Government schools. Moves are being made to establish a matriculation level information processing course.

Teaching With Computers

2.57 Utilisation of the computer in secondary schools occurs within a range of subjects such as business education, science, social studies, mathematics, home economics and health education. A current limitation on this use of computers is the relative lack of high quality software packages appropriate to the educational programs in Western Australian schools.

2.58 In primary schools the computer is used as an integrated learning resource in the normal teaching-learning programme. The Education Department has developed a relatively small number of high quality software and teaching packages for use in such areas as geography, reading and spelling, health, mathematics and social studies. Inprimary schools, computer technology is not expected to replace teachers as the main facilitators of learning. It is accepted that the computer can serve as an educational resource to motivate students and to stimulate and enhance problem-solving abilities through the use of computer-assisted learning techniques provided these are carefully integrated into the total education programme. The Department sees little value in committing scarce resources to supporting computer-managed learning systems in primary schools and at this stage activities in this area are not supported.

School Administration

2.59 The Education Department provides relatively little support for the administrative uses of computers in schools because it sees the main uses for school-based equipment as being in students' educational programmes. Nevertheless the Education Department does provide a secondary school timetabling system which is used by most high schools and senior high schools. This system runs on a large central computer in Perth. Currently the potential benefits related to the use of computers in school libraries is being investigated. It is possible that there will be developments in this area in the next 18 months.

Present and Future Problems

2.60 The areas for study and future development include:

- Establishment of a sound and convincing basis for deciding which educational uses of the computer are worth supporting and which are not.
- Establishment of a body of pedagogics related to the use of computers in schools.
- Teacher training and retraining.
- Establishment of mechanisms for interstate co-operation in the sharing and distribution of software and teaching materials.
- Enhancing school computing courses.
- Developing a contribution from the educational sector to the advancement of an Australian information technology industry.
- Examining the cultural influences of imported software.
- Establishing proper relationship with commercial suppliers of computer hardware and software.
- Monitoring the impact of computer-based information services on other school resources.

SOUTH AUSTRALIA

Policy Statements

2.61 The material on South Australia is derived from a policy paper "Policy Statement on School Computing Activities" of November 1982 (78) and discussions with senior offices in May 1983.

2.62 The South Australian Education Department recognises that it has a responsibility to manage and support development of the use of computers in schools. It believes that computers and related technology will become more pervasive in our society and if students are to function as informed citizens, they will need an understanding of the capabilities and limitations of computers. This understanding should develop from computing courses offered by schools, actual student use of computing in schools and the student's experience of effective use of computing by the school itself in managing its education programme. The following statements are accepted as basic premises underlying development in educational computing:

- computing is an object of study in its own right
- computing provides the means of enhancing and extending traditional components of the school curriculum.
- computing and related technology have the potential to change the curriculum, the manner in which that curriculum is implemented and to improve the general organisational procedures used by schools.

Implementation

2.63 The Angle Park Computing Centre (APCC) is the focus of responsibility for the day-to-day activities with respect to computing in schools. It is planned that school access to computing hardware will be provided by microcomputer based systems in schools with a central component located at the A.P.C.C. Information relating to software, hardware andteaching techniques will be developed at the Centre and disseminated to regions and schools. It will act also as the State's Clearing House for all information relating to computers.

2.64 The chief ways in which computers are being used in schools include 'teachng about computers' and 'teaching/learning with computers'. The former involves:

- Computer Awareness Courses which involve the development of sufficient knowlege to enable a student to make informed decisions both of a general and social nature about computers in the service of people and hence as part of the environment. This would include awareness of the power and the limitations of the computers.

- Computer Studies which is a formal study of the function and application of computing and will be taught at the senior level.

- Computer Electronics, the demand for which has been met for some years by the offering of electronics electives in physics courses and it is likely that the demand for such courses will continue to be satisfied in this manner.

The latter involves the computer as a teaching/learning resource which is integrated into the school programme or into specific subjects, and is described as:

- Computer Assisted Instruction (CAI) in which the computer is used for drill and practice purposes.

- Computer Assisted Learning (CAL) which enables the students to use the computer as a learning aid and may be described as teacher-directed and learner-controlled use of the machine.

- Computer Managed Learning (CML) in which a computer is used to organise and keep records of individualised learning.

- Computer as an electronic blackboard in which the computer is used by the teacher to present materials in a dynamic fashion.

2.65 In respect to equipment, the Apple II microcomputer will continue to be supported by the Angle Park Computing Centre as a teacher professional development and teacher demonstration system, although new Apple II specific software will be given a low priority for development. Recently a call for tenders for a Local Area Network of Microcomputers resulted in the BBC microcomputer/Econet system being chosen as the recommended system for school use, but it is intended that the BBC microcomputer will also be supported as a stand alone system. South Australia

has a support service for schools in relation to the purchase of equipment. The Angle Park Computing Centre will discuss school plans, demonstrate the recommended hardware and a range of software, and assist the school in preparing its submission seeking approval to purchase. Following approval, the Centre will place the equipment order on behalf of the school and check the installation prior to the school making payment. It should be noted that the list of recommended equipment will be modified as the need to do so arises. New equipment is evaluated by the Centre as it becomes available. To provide continuity and regardless of changes in the recommended equipment list, systems that are approved will be actively supported for at least three years and at a lower level for a further two years.

School Priorities 1983-1984

2.66 For the next two years priority will be given to computing in secondary schools and within those schools to the support of teaching about computers and teaching/learning with computers. In primary schools the emphasis will be on teaching/learning with computers. Where CAI material is used, teachers have been advised that it is not regarded as a teacher replacement but rather as an additional resource to be used by the teacher. While the use of the computer as a tool and as a part of recreational activities for primary school children is supported, highest priority will be given to the use of the computer to support and extend existing curriculum activities and to the integration of educational computing into school curricula as a motivational device.

2.67 South Australian policy recognises the vital role which teacher attitudes will play in the effective development of computer use in schools and is supporting and will further support in-service professional development programmes to ensure that all school staff understand the computer and have the opportunity to gain the skills required to enable them to use computing and related technology effectively.

Tertiary Developments

2.68 The Tertiary Education Authority of South Australia (TEASA) (79) has established an Academic Advisory Panel on Computer Education to review computer education in tertiary education institutions. The eighteen member panel is drawn from the Authority, Education and TAFE Departments, Universities, Colleges, computer manufacturers, and computer users in business and industry. The Panel has been asked to report to TEASA on whether tertiary education programmes are being suitably adapted to take account of

developments in computer technology, or whether there is a need for new courses or modifications to existing courses particularly in pre-service and in-service teacher education and whether the implications for tertiary education of developments in computer technology and its applications are being effectively monitored and/or whether there is need to set up machinery for on-going review and co-ordination and the nature of such machinery. The Panel is expected to report later in 1983.

TASMANIA

The Present Position

2.69 The material on Tasmania is derived from a position paper "Educational Computing in Tasmania - Recent Developments and Emerging Issues" (83) and discussions with senior officers in September 1982 and July 1983.

2.70 Tasmania has had a relatively long involvement with educational computing. It was the first state to establish an accredited Computer Studies subject (offered since 1972) and the first to develop a statewide timesharing network for educational purposes. This network now supports approximately 250 on-line terminals in all major population centres.

2.71 The focus for educational computing in Tasmania is the Elizabeth Computer Centre (E.C.C.) established in 1975, which services the computing needs of the Education Department. The functions for which E.C.C. is responsible include the development and maintenance of the network; the development of educational and administrative software for the network and for microcomputers; the provision of expert advice on computing to the Department, to schools and to colleges; the provision of advice and training to Tasmanian teachers and the production of the regular newsletters, "Classroom Computing" and "Microcomputer News"(83).

2.72 The Director-General receives advice on computing developments from the Computer Management Committee. This committee lays down general policy guidelines for development which it is the responsibility of the Officer-in-Charge to implement. The responsibility for maintaining computer operations lies with the Senior Education Officer (User Services) and the provision of advice and courseware to schools is the responsibility of the Co-ordinator of Educational Computing. Both of these officers and their staff are members of E.C.C. which has a total staff of 22.

2.73 The Tasmanian Education Department Network (TASNET) services schools, colleges and administration offices throughout the state. TASNET currently consists of one Digital VAX 11/780, three PDP 11/70s and two PDP 11/34s with a total of 1000 megabytes of on-line disk storage with off-line magnetic tape back-up storage also available. The processors are situated in Hobart, Launceston, Devonport and Burnie and are connected by high speed dedicated Telecom lines. The 250 on-line terminals are linked to the network by dedicated Telecom lines which connect them to the nearest computer in the network. All Further Education Colleges and every high school (except one) now have on-line facilities, as well as several district high schools, one primary school and Education Department branches. A typical college would have between six and eight terminals and a typical high school would have two or three terminals.

2.74 In addition to the on-line facility, there are over 100 microcomputers located in Tasmanian schools, plus 10 loan units available to schools from the E.C.C. Schools have usually purchased the micros in addition to their TASNET terminals. However the current expense of Telecom lines (calculated on the distance of the school from the nearest computer) has resulted in several district high schools using only microcomputers. Recent Education Department policy supports the educational use of computers in primary schools and this is occurring largely through the use of microcomputers. As the Education Department, through E.C.C. and the Tasmania Media Centre only supports and maintains BBC Microcomputers and Apple Microcomputers, schools have standardised upon these systems thus allowing for increased resource sharing. In addition to being used as stand-alone units these microcomputers can also be used as terminals by schools dialling into TASNET on ordinary telephone lines.

Courses in Computing

2.75 A wide range of courses, both formal and informal, are now available in Tasmanian schools. A university accredited HSC Computer Studies subject has been offered since 1972 and now has enrolment levels similar to many of the traditional subjects. The majority of students undertaking this course do their practical work on the TASNET system rather than the microcomputers. There is also a formal, certified School Certificate subject, Computer Studies, offered to Grade 9 and 10 students. There is a heavy practical emphasis in the course with students using a wide variety of pre-written packages as well as learning a programming language. A number of schools are now teaching one of three computer literacy courses which have been

developed by the Elizabeth Computer Centre (81). The emphasis is generally on the social implications of computers with hands-on experience being directed towards the use of packaged software, although the fifty-hour course does have a significant level of programming in it.

2.76 The Tasmanian Education Department has accepted as policy the use of computers in primary schools(82) in the areas of computer-assisted learning, computer awareness and problem solving. Much of the programming effort of the Education Section is directed towards the development of Computer Assisted Learning software for primary school children. It is anticipated that students will gain an awareness of computers by using them for learning, rather than through formal computer-oriented courses. Primary schools do not receive direct financial assistance for the purchase of computing facilities, but as with other sectors, software support and free maintenance are provided to schools which purchase recommended systems. For primary schools this is a 32K disk-based BBC Microcomputer.

Administration Applications

2.77 Tasmania has always been keen to exploit the resource sharing capability of an extensive computer network and a number of systems have been developed for teacher support. These systems allow teachers, school librarians and administrators to manage the learning environment more efficiently. TASCIS is a system which relieves librarians of much of the tedious work surrounding cataloguing and releases them for more important work within the library. Catalogue cards are automatically produced after an on-line search of over 100,000 items. The Tasmanian Media Centre is the audio visual equipment branch of the Education Department, and as such is responsible for the distribution of all films, slides, video tapes and kits. They use a computer based circulation system from which schools can gain information about the range and availability of resources. The ISIS system is a computer based aid to moderation. Teachers are able to select a test from a large item bank in their subject area. The computer then marks and analyses the test and compares the students' results with the State average for each question. Other systems include CIRSYS (a library circulation system), ABC Reporter which allows teachers to access information on forthcoming radio and television programmes and Mail which provides a complete communications facility across the network.

Teacher Development

2.88 The University Centre for Education (UCE) and the Tasmanian College of Advanced Education provide a number of courses as a part of formal pre-service training of teachers. Also available are formal accredited in-service courses which a teacher would use to upgrade a Diploma of Education qualification or as part of a Bachelor of Education degree. The Elizabeth Computer Centre conducts a number of formal non-accredited seminars each year for teachers from Tasmania and interstate. Occasional conferences are also conducted by the Computer Studies Teachers' Association. These seminars are usually very specific and are designed to assist teachers with day-to-day problems they face in the classroom.

Emerging Issues

2.89 The identification of issues is always difficult in a rapidly changing field. However, there are some which are certain to gain prominence in the near future. For instance the limited resources which State Education systems can devote to the production of high quality software implies a necessity for co-operative development. Software exchange between States or through a national clearing house would be desirable. The TASNET system is soon to be connected to CSIRONET thus providing access to facilities throughout Australia and also providing a gateway to international information systems. The Tasmanian Education Department regards the ability to have ready access to international data bases as highly desirable for all school children.

While the provision of a reasonable level of computer literacy for all students is seen as being of vital importance, the availability of computer literacy courses should not be restricted to school age students - the wider question of courses for adults is an emerging issue. Finally the improvement of the efficiency of schools and administrative offices through the use of high technology is another matter which needs close attention. Schools need to be provided with the software and hardware to enable school-based budgetting to occur. As a part of this process administrative offices and service branches are being given access to TASNET to allow word processing, document transfer, automatic typesetting, on-line conferences and similar facilities to be utilised.

NORTHERN TERRITORY

Policy and Goals

2.90 The material on Northern Territory is derived from "Information Statement 13 - Computer Education"(75) issued in May 1983 and discussions with senior officers at that time.

2.91 Northern Territory policy on computer education is that schools shall use computers where appropriate for teaching and learning across the curriculum and provide opportunities for all students to learn about and become literate in the use of computers. In pursuing this policy the Northern Territory is able to take advantage of developments in other States and is benefitting from that experience.

2.92 One of the overall goals of the NT computer education programme is to teach about computers through computer awareness and literacy courses and through computer studies. Computer awareness and literacy courses will be designed to enable a student to make informed decisions about computers, including an awareness of the power and the limitations of the computer, and to make basic use of the equipment. Computer studies at the secondary school level will involve a formal study of the function and applications of computing.

Course Approaches

2.93 In primary schools the emphasis will be on some hands-on experience for all students leading to a general computer awareness. This will involve using machines of limited capabilities to develop basic keyboard skills and familiarity with the computer equipment. In junior secondary school, all students will be taught computer literacy. This will extend from the primary school stage so as to create an awareness of the limitations and capabilities of computers and their impact on society. Keyboard skills commenced at primary level will be developed further and students will learn to deal with computers in a more sophisticated way. Students will begin to learn about computer applications. At senior secondary level, some computer courses will become more vocationally orientated. Accredited computer courses associated with the NT Senior Secondary Studies Certificate will be offered. These courses will be basically of two kinds, one concerned with computer studies and the other concerned with business data processing which will involve word processing.

AUSTRALIAN CAPITAL TERRITORY

System Level Activities

2.94 The material on the Australian Capital Territory is derived from a position paper "Computing Education"(69) prepared in October 1982.

2.95 The Computing Services Section of the ACT Schools Authority has overall responsibility for the introduction and maintenance of computer systems for administrative use in the Schools Office. This section also manages the Deakin Computer Centre. The Consultant (Computer Studies) from the Curriculum Consultancy Section advises schools on the introduction and educational use of computers in schools, particularly microcomputers.

2.96 The Schools Authority has no stated policy on the use of computers in schools. This area is, however, currently under discussion. In November 1981 the Authority issued a discussion paper, "Computers and Education in ACT Schools" and sought responses to it from schools and their boards. At recent meetings the Authority has considered policy proposals but to our knowledge has not yet issued a policy statement.

School Level Activities

2.97 The major areas of concern about the use of computers in schools include the lack of sufficient suitably qualified teachers; the limited amount of educationally sound, relevant computer software; and the cost of suitable hardware which has prohibited most schools from buying more than one microcomputer. The first two problems have begun to be addressed at the system level and should gradually improve in the ensuring years while the third is being solved by the continualy falling price of hardware.

2.98 In respect to 'teaching about computers', computer literacy units are being offered in primary schools which have computing equipment which is about 20% of primary schools. Typically this is taking place in Years 5 and 6. Every high school in the ACT is offering some form of computing course, either a computer awareness or computer programming course. The computer awareness courses are based on the traditional model - i.e. consisting of the following components: historical aspects, system structure, using a computer, applications and social implications. These courses are typically elective units offered in Years 9 and/or 10 and are usually either a semester or one year in length. At the secondary college level there is a

common tertiary accredited course (developed by teachers from all colleges) consisting of six one term sequential units. This course has been in operation since 1976. The course called Computing Studies covers the topics of the high school computer awareness course but in a much more rigorous and detailed way. All colleges offer also an accredited course called "Computers in Society". It consists of three non-sequential one-term units and aims to cultivate an awareness of computers in society, their limitations and potential and their implications for society. The course is aimed at the bulk of students who simply wish to know a little about computers and how they can be used. There is a strong emphasis on hands-on activities.

2.99 The area of 'teaching with computers' is still in its infancy in the ACT. The current use of computers for CAL in ACT schools include at the primary level, remedial spelling, reading, mathematics problem solving using LOGO, history and geography using simulations; at the high school level remedial mathematics, geography andscience simulations, business studies, typing and accounting social studies, and at the secondary college level business studies, word processing, accounting, science simulators, and remedial mathematics.

2.100 Since 1976 secondary colleges have been using the Deakin Computer Centre computer to store and process student academic records. Peripheral to this are several minor programmes to assist college teachers in the process of moderation and standardisation of scores. Several colleges are using a word processing package available on this machine to store, update and print their prospectuses each year. The student administration package called CASA (Computer Assisted Student Administration) is currently being extended to make it suitable for and available to high schools and eventually to primary schools. Besides keeping student academic records CASA provides other facilities including timetabling, class lists, student reports, statistical analyses, the printing of Year 10 certificates and production of address labels. Besides the facilities offered by CASA a few individual schools (mainly high schools) are doing some minor administrative tasks on microcomputers. Schools are not encouraged to use microcomputers for school administration because generally the hardware is not suitable and funds could be put to better use in the classroom.

2.101 With the exception of a computerised film booking system being used by the O'Connell Education Centre Library at system level, little use is being made of computers in

libraries. A few school libraries are using computers for minor tasks such as printing catalogue cards. However, interest is being shown in the potential use of computers in school libraries and as suitable software becomes available more and more libraries will most likely make use of computers. A large proportion of ACT librarians have done library courses involving units on computing.

DEVELOPMENTS AT THE NATIONAL LEVEL

The Australian Education Council

2.102 For several years the Australian Education Council consisting of Ministers of Education and its Standing Committee consisting of senior officers of departments and agencies in education have agreed that computers in education is an important area for its consideration. Lack of funds and differences in the degree of development of State policies, particularly at the school level, have precluded fruitful discussion.

2.103 At its meeting in May 1982 the A.E.C. invited Victoria and New South Wales to prepare a paper on the main issues including computers within all sectors of education. In May 1983(67) the Victoria/New South Wales group recommended inter alia, that a small representative group should prepare for the A.E.C. a statement of principles and priorities applicable to the use of the teaching about computers in education across all sectors of education, advise on the consultative mechanisms appropriate for interstate co-operation and recommend on mechanisms for the ongoing monitoring by the A.E.C. of the various co-operative activities relating to computers in education.

2.104 At the same meeting in May 1983 the A.E.C. also had before it a set of proposals arising from a meeting in Perth convened by the Conference of Directors-General and attended by their experts in computer education (68). At the same time, the Commonwealth Minister of Education announced the establishment of the Schools Commission National Advisory Committee on Computers in Schools.

2.105 The A.E.C. decided that further consideration of the use of computers in primary and secondary schools would take place within the Commonwealth Schools Commission's National Advisory Committee but that the related needs and responsibilities of the tertiary sector should be fully taken into account before final decisions were made. In this way it was hoped that the need for national consideration of both the school and tertiary components in

the use of computers in education would be possible. The links between the tertiary and school sections are therefore being acknowledged but are not yet clear.

The Commonwealth Schools Commission

2.106 In 1982, the Federal Government announced the provision of funds for computers in schools. The Labor Government newly elected in 1983 accepted the need to support this action and the Commonwealth Schools Commission was asked to establish a National Advisory Committee on Computers in Schools. The Committee was asked to prepare a report by the end of August 1983 on a range of matters relating to schools computing. After discussion of the report with relevant authorities, the federal government will then announce the manner and extent of its assistance.

2.107 The National Committee is chaired by Dr Peter Tannock, Chairman of the Commonwealth Schools Commission and has 21 members drawn from each State and several national groups. The National Committee has established six Technical Working Parties to advise it in the areas of professional development, curriculum development, software/courseware, hardware, support services, and evaluation.

2.108 The terms of reference state that the National Advisory Committee on Computers in Schools will provide advice to the Commonwealth Schools Commission on a broad range of matters relating to schools computing. In particular, it has been asked to provide advice on the following:

- the use of computers in schools as they relate to the educational needs of boys and girls enrolled in primary, secondary and special schools;
- the rationale for a national programme, including desirable short and long term educational, social and economic outcomes;
- an implementation plan and associated guidelines for the introduction of a national Schools Computing Programme into primary, secondary and special schools, including its integration with State and non-government school policies and provisions. This plan should include options for the allocation of funds among States and sectors, advice on desirable minimum standards of provision, and on ways of achieving an equitable sharing of resources and services across Australia;
- a plan for generating and supporting discussion and awareness within the community and especially within

school communities of school computing and its applications;

- evaluation activities relating to computing in schools and to the provision and operation of the proposed national programme and
- other matters which may be referred to the Committee by the Commission.

2.109 The outcomes of this report are expected to be most significant for the future development of computers in schools. In fact most States, including Victoria, have announced that further developments of policy and practice will not be made until after the report has been received, discussed, and Commonwealth policy decisions made clear. The findings of our Report will be made available to the Schools Commission for its use.

Organisation for Economic Co-Operation and Development (OECD)

2.110 The OECD (Organisation for Economic Co-Operation and Development) has continued its work (101,115) in computers and technology in education as has CERI (Centre for Educational Research and Innovation). CERI is in the process of investigating two aspects of the increasing sophistication of the new technology and the consequent change of scale in information processing. The first aspect to be considered is the impact of the technologies on the role and structure of education systems, and the second is their impact on the teaching/learning process. The work is to be undertaken in two phases and will encompass all the principal levels of education. The first phase of two years entails information gathering and clarification of main issues in preparation for an international conference in late 1983. The second phase, from 1983-1985 will consist of specific development activities considered urgent in the light of the conferences' conclusions, for example, home based learning facilities or the transferability of software.

2.111 The first phase now under way is to consist of country-by-country enquiry of major trends and policies at all educational levels with particular reference to computer assisted instruction, software, teacher training and educational use of telecommunications. Australia is participating in this enquiry.(101)

The Tasmania, South Australia and Western Australia Consortium

2.112 Tasmania, South Australia and Western Australia by 1982 had developed an agreement which enabled them to act as a consortium (68,85) in respect to the sharing of software and information on courses, programmes and . support services. All three have supported BBC Acorn computer equipment and have intended, over a period of time, to phase in this equipment for their secondary schools. This consortium was expected to facilitate the sharing of resources and information between the three and allow substantial economies. Recently Western Australia has also lent its support to the MicroBee.

2.113 The existence of the consortium however, has been seen by some other States as producing problems because it preempts national co-operation unless the other States conform to the details of the consortium agreement and some States have already committed themselves to different kinds of equipment and educational policies. On the other hand, the consortium had indicated some reluctance to include other States unless, understandably, they were prepared to conform to the specifications of the three-State agreement and could provide a financial commitment to such agreement. It is hoped that the discussions within the School Commission's Advisory Committee on Computers in Schools will assist in bringing all States together in the pursuit of nationally determined objectives.

CHAPTER THREE

OVERVIEW, ANALYSIS, SUMMARIES AND RECOMMENDATIONS

OVERVIEW

3.1 A major problem underlying the use of computers in schools at the present time relates to the absence of a clear rationale for their introduction and agreed upon aims and objectives for their use.

3.2 Regular information about computers and software in the press, journals, media and through advertising has led the public to accept that computers are becoming an integral component of modern living, particularly in business and industry. High level and sophisticated advertising and news coverage about computers in the daily press which indicates the latest developments in equipment and the time saving economies that result from its use, together with social phenomena such as the computer arcades which are replacing pinball parlours for the young, have led to an implicit assumption that the public must keep up with new technology. This assumption is reinforced by frequent reports about developments in medicine, scientific research, finance and the handling of complex information through the use of computers.

3.3 Almost everyone today is affected in some way by the increasing use of computers, in personal banking, health, car and house insurance, purchase and supply of goods and centrally stored personal records such as taxation and pensions. An important question is what does the public need to know about computers, and for what should we train our children?

3.4 Not everyone needs to know how to use a computer, although more widespread use by the individual in inevitable. Not everyone needs to know how a computer is constructed electronically; and while programming is a fascinating intellectual exercise creating to some extent its own logic-oriented elite, not all wish to submit to the rigorous and detailed routine of being able to programme a computer. Many prefer to leave it to those who are interested and wish to become skilled in programming. Perhaps some knowledge about the effects of computers on society and their applications to everyday life is the essential component of learning about computers for most people.

3.5 However for our youth the situation is more urgent. Jones (109) predicts that due to the technological revolution there will be fundamental changes to the human condition and to the role of the individual in his economic, social, political and recreational situation. The young will need to know.

3.6 Most teachers in our society are struggling to keep up with new, persistent and often conflicting demands on schools to develop school based curricula which include health, physical education, sex education, politics and environmental matters and also to train children for a vocation or a career. Few teachers have sound experience of computers or knowledge of programming. Even fewer are able to foresee the social and technological implications of computer use in society. Nevertheless there are demands on them to introduce into the classroom the computer in the form of computer-aided instruction (CAI) computer managed instruction (CMI) familiarisation programmes, computer literacy, programming, systems analysis and other aspects of computer use, some of which are defined only with difficulty.

3.7 It is clear that determining what students really need to learn about computers is of great importance. Of almost equal importance, but dependent on students' needs, is the preparation of teachers with appropriate training and expertise. Dependent on this second factor, is the availability of suitable trainers of the teachers. So we have three ascending and interdependent levels of requirements, all of which must be met before a satisfactory educational system incorporating computers and other new technology is in place.

Courses

Familiarisation Courses

3.8 Familiarisation or computer awareness courses at school level and tertiary levels are likely to have a limited life as the use of computers in the community becomes greater. Planning outlines for familiarisation courses should include a three year review process for relevance assessment. (96,103,108,113,114,115,120,124,125)

Social Implications

3.9 An important component of familiarisation courses must be the teaching of social implications of computers and other new technology. (116,124) Teachers however, will have difficulty in maintaining an overview of what the social

and economic effects are unless there is a mechanism for transmitting consolidated and wide ranging information about the effects of computer use in commerce and industry. The separation of the two parts of society - education and industry - should not continue. It is desirable that business and industry accept responsibility for monitoring changes in productivity, personnel and profit as a result of using new technology (106,112,122,125) and provide this information to a body such as a government sponsored research unit. The information could then be collated, integrated and disseminated where appropriate to allow a better overview of changing events. If the technological revolution is as significant as Jones (109) claims, lack of knowledge about changes cannot be permitted to continue. Interestingly, for the first time in history, the calibre of the new technology itself may enable it to be used to assist in observing the changes it generates.

Computer Aided Instruction (CAI)
Computer Aided Learning (CAL)

3.10 Programmed instruction has become more sophisticated through the application of computers to objective-based step by step learning. The computer adds the new dimension of moving visual display, and provides much greater flexibility in adapting the programme to students than has hitherto been possible with written or other materials. (121) While the style of instruction can improve through the use of computers, the kind of learning involved has not changed. CAI/CAL are useful where the intention is to teach using behavioural objectives, monitor students' progress, identify learning difficulties in a precise way, and convey certain kinds of subject matter (100,104,118) However, the reason for using CAI/CAL must be based on a real educational purpose and not on the availability of a computer with some software. Education goals should not be perverted because of the attraction of new equipment and pre-packed materials.

Computer Managed Instruction (CMI)

3.11 Proponents of CMI generally have access to a fairly large computer system, either mini- or main frame, which can handle large amounts of data at one time and run banks of tests. Wherethe number of students involved warrants it, CMI can be a most useful administrative and diagnostic tool. It is not a replacement for the teacher but allows the teacher access to collated information about students and their progress. For small institutions dependent on banks of microcomputers, the cost effectiveness of using CMI needs careful prior assessment.

Curriculum

3.12 Handling curriculum for use with computers is probably the most controversial area in the 'computers in education' debate. The software which is acquired for teaching in schools and in higher education requires careful planning for cost-effectiveness and educational validity.

3.13 Computers can be used to perform functions that cannot readily be done by other equipment using other media e.g. simulation and model design. (118) The computer at its best can allow complex tasks involving the control of many variables to be undertaken, and deal with situations which are too difficult or dangerous to replicate in reality. Thus in mathematics it reduces time spent on calculations in physics and in statistics allows the exploration of large data bases with options not readily possible through manual calculation. These applications are relevant at upper levels of education and the computer provides a new tool which expands understanding in a most exciting way.

3.14 Computers can be used to perform functions that can be done by other equipment, used singly or in combinations. This use can be beguiling because at lower levels of primary and junior secondary education it is not uncommon for many manhours of programming effort to be placed into the development of curriculum software which has only marginal, if any, advantage over the kind of learning which would result from the use of other tools e.g. films, TV, overhead projectors. (120) It is necessary to assess beforehand the value of developing computer programmes to assist with routine teaching tasks and subject matter which have been quite effectively dealt with in the past by other means. The computer must be more than a novel tool to justify the time and effort required in preparing good programmes which are applicable over a period of time and preferably for more than one class or school. (121) New developments, such as Sony's video responder, a computer controlled video tape system may have more attractiveness and versatility for some curriculum applications in schools.

3.15 The potential for improving learning through suitable computer programmes designed for curriculum purposes is not in question, but the extent of the investment of time and expertise which are essential for success means that careful consideration of the subject matter and its suitability for computer presentation are pre-requisites of high quality programmes. Trivial programmes will do more harm than good.

Programming

3.16 Scriven (120) has written that "It's already obvious that teaching programming languages is going to be about as useful as teaching Tibetan, which is not to say useless for everyone but simply indefensible as a requirement for everyone". The role for the school in teaching programming should be related to the provision of specific training for career and vocational purposes, or as electives for those who wish to develop programming skills but not with the thought of becoming experts.

Inservice Training

3.17 The preparation of teachers for working with computers in schools and the development of interested and positive attitudes through planned educational programmes for the use of computers is crucial. (98,99)

3.18 Teachers need advice enabling them to become familiar with the use of computers, their applications to and effects on society and their use as a tool to assist with the delivery of curricula. In some cases, knowledge of programming and several computer languages may be an advantage. Decisions on these aspects will depend on the general educational rationale which we are recommending should be developed for the use of computers in schools.

3.19 The model adopted in France (8) of selecting a small group of experts to train a larger selected group of teachers to act as in-service consultants could serve as a basis for a strategy for in-service training in Victoria. Alternatively, the juxtaposition of both programmers and curriculum experts in a central directorate to form a group of senior consultants to train teacher consultants on a large scale, as has been done in California (29) also has merit. Whatever the model adopted, the key factor is the availability of appropriate top level expertise to train a larger group of teachers who can then act as consultants across the State or in the regions.

Equipment

3.20 The free choice of equipment by schools, often determined by substantial discounting from commercial computer firms has in some States resulted in the purchase by schools of a range of incompatible and sometimes unsuitable equipment with consequent uneconomic investment of funds.

3.21 For the large scale preparation of good software and the effective training of teachers to use computers, the range of equipment used by schools must be restricted. (13,17,18, 23,38,78,80,94) Views differ on the development of an Australian-produced computer designed to meet planned educational requirements because of the now commonplace experiences in various parts of the world where major commercial firms have undersold government sponsored equipment. (56,68) However the need remains to design or specify the kind of equipment which will meet the desired objectives of computer use in schools but which will permit also the easy transfer of software, the use of common computer languages, and easily available service support and consultancy advice.

Software

3.22 The preparation of good software encounters problems similar to those faced by the curriculum developers of the sixties and early seventies. Curriculum material is very expensive to produce in terms of time and facilities, and needs to be versatile to meet the needs of many teachers. Few teachers as individuals have the time to prepare their own materials, and this is even more necessary for the preparation of computer programmes. Overseas experience (13, 18,56) has shown that teacher-authored software tends to be of lower quality and rather specific material not widely applicable.

3.23 The development of software may best be begun by the establishment of state curriculum groups comprising programmers and curriculum experts. The expertise of audio-visual technologists would also be a most desirable element in the preparation of software because of the improved visual presentation that would ensue from such sources of advice. (121) Initiatives from teachers who wish to develop programmes should be actively encouraged but not relied upon as the main source of widely applicable software.

3.24 Close consultation with subject associations should provide a useful source of curriculum expertise when combined with programming skills and audio-visual technology skills particularly for programmes using graphics and other forms of pictorial display.

Inter-sectoral Collaboration

3.25 The various education sectors, primary, secondary and higher education have in most countries acted independently of each other, although there has been some collaboration or dialogue between primary and secondary levels. In some cases, as in Alberta, (56) a good deal of thrust for the introduction of computers in schools has come from the research and development activities of the two major universities but this is more the exception from the rule.

3.26 As the in-service and pre-service training of teachers is directly dependent on expertise available at higher educational levels, the links between those levels must be strengthened and each should become aware of what the other sector is attempting to do. The preparation of a rationale for computer use in schools should involve dialogue between all sectors of our educational community and to be really effective should extend to our industrial and commercial organisations.

3.27 The use of computers in education in overseas countries varies substantially. The education systems in certain countries, China, Yugoslavia, and Thailand are not sufficiently funded to bring computers into the classroom at this stage of the development of those countries. They do not have any significant developments in computers relating to schools which would point to ways in which Victorian or Australian schools would benefit.

3.28 In other countries, the most significant being Japan, the heart of the computer chip industry; Germany with ample resources; and Sweden also well able to support new technological developments in education, computers are given little place in schools. Herein lies a fundamental conflict of philosophy concerning the use of computers in schools. These countries, despite their resources, advanced education systems and advances in technological development, have chosen not to introduce computers into schools for a variety of reasons.

3.29 In Japan, children have ready access to computers in their daily lives. The equipment is cheap and readily available. Computer games, video-tex, home computers, and computers used in shops and libraries are commonplace. There is therefore seen to be little need to introduce children to computers in schools. When people are employed by Japanese firms, the firm takes responsibility for training the employee in programming, systems analysis or other required skills, and focuses on training him or her for the job as part of the firm's lifelong commitment to employees. Preliminary training at school is not regarded as of prime importance, although some courses are available at senior level. Training in computers is rigorous, specialised and seen as the responsibility of the employer or agency at the appropriate time. Perhaps the Japanese situation where goals and responsibilities appear so clear cut is an enviable one for the educator. However its implications for our society may be limited since, among other things, sociological differences, employer-employee relationships and the stress on achievement and academic performance in Japanese schools are not compatible with our way of life or educational philosophies.

3.30 In Germany (Hamburg, North Rhine-Westphalia and Bavaria) the education system is heavily traditional. (2,4) Changes are not easily accepted or implemented. Computers are seen as a technological tool for industry and commerce, and although essential for many economic, financial, and scientific developments are not considered of great importance in the school curriculum. The highly organised and centrally oriented curriculum for elementary and junior years has not been adapted to any great degree to

incorporate the computer as a teaching or learning aid, and the dual system of education at upper secondary level does not permit much flexibility in experimenting with computers in schools, unless there is a direct need vocationally for their inclusion. The importance of the teacher-pupil relationship is stressed and is consistent with the traditionalist viewpoint. In Bavaria some experimental work has been done in the use of computers in schools but it has been relatively limited compared to initiatives in other Western countries.

3.31 In Sweden most of the upper secondary schools have computers for Years 10-12 and they are used for both familiarisation, and instructional purposes. There are some plans underway for introducing them for administrative use in the next couple of years. The Swedish education are not too anxious to introduce computers on a widespread scale.

3.32 In contrast, France, United Kingdom, USA, Canada and to a certain extent Norway have a heavy investment in computers in education.

3.33 France, (8) which regards its economic survival as dependent upon its development of high-technology has a well established programme enabling schools to use computers for familiarisation and instructional programmes, and administrative purposes.

3.34 In developing this programme over a number of years, France has made a serious and interesting attempt to overcome the problem of teacher training. Twenty-five computer education specialists located in units in several universities have had assigned to them the task of developing the relevant computer expertise in teaching staff selected for their interest and abilities so that they can act as consultants offering in-service training to teachers in schools. Five hundred teachers have been trained as consultants. The precise extent to which the 500 trained teachers are sufficient to be effective in being able to cope with the number of teachers in schools requiring in-service training is not known, but the overall strategy appears to be a useful model.

3.35 The United Kingdom has also a well established programme for schools, the Microelectronics Education Programme backed by government to place computers in schools and train children in computer awareness and further skills. (17) Before the Programme was introduced there were lengthy and careful consultations with Local Education Authorities and boroughs, and a number of options on the

nature and implementation of the Programme considered. A unique characteristic is the provision of funding from the budgets of both Education and the Department of Industry. This combination of school and work authorities has encouraged confidence in the public that the effects on their children's education will be positive and worthwhile. Another result of these discussions is that the Programme has a well identified rationale and policies, which are interpreted locally but with a unifying commonality. From our point of view, the MEP development in the U.K. probably represents the most relevant centrally devised but regionally administered attempt to introduce computers into schools.

3.36 The production of good reasonably cheap software and teacher training are features of the MEP. Teacher training covers four aspects of computers, the equipment, computer based learning, information processing and electronics technology, and is organised through in-service centres of the LEAs. In-service training is mainly of frequent, short duration sessions with some residential courses ranging from one to several days in length.

3.37 The Scottish counterpart, the Scottish Microelectronics Development Programme has also developed rapidly since 1980, (23) with a one hundred fold increase in the number of computers in schools in two years. Teachers are encouraged to develop their own software for shared use, and centrally developed software for various subject areas is available for use in schools and for the training of teachers. We should note the concern about the quality of much of the teacher-developed software and the resulting emphasis on the allocation of resources to development of software in decentralised centres. It is also noteworthy that standardisation of hardware is believed to be a significant factor in facilitating teacher training programmes because it permits high quality experience with a restricted range of equipment.

3.38 The U.S.A. exhibits, predictably, a wide range of developments at varying stages. In California a highly sophisticated centralised and commercial programme under Professior Patrick Suppes using CAI has been introduced complete with intensive evaluation techniques which are, so far, not very evident from many other countries' activities in computers in education. There have also been some expectations that the larger educational publishers would bring their resources into the field of developing software. Surprisingly, this has not occurred to the extent anticipated. As a result there tends to be a surfeit of lower-quality materials produced by individuals and smaller groups, which are difficult to monitor in terms

of standards and distribution. Although, the efforts of less professional authors should not be discouraged, the lack of transferability and validity of some of their materials may in practice be counterproductive if they are used by teachers not fully convinced that computers are necessary in schools. There is also a lesson here for our own procedures.

3.39 In Canada almost every province has, for a number of years, been introducing computers in schools. (56) There are quite wide differences in the degree of development between the provinces, with the larger ones having attempted more than the smaller, not necessarily with a greater degree of success. To some extent there are some parallels evident in the developments undertaken by the Canadian provinces and the developments which are now occurring in Australian States. Almost all the provinces have entered initially into the computers in education exercise with some intensity but not with a great deal of planning. They have considered the problems of standardised versus non-standardised hardware and have run into common problems with commercial enterprises pressing ahead with new developments and over-running technically the attempts of educational authorities to prepare teachers for the use of the equipment in schools.

3.40 From the information available it seems clear that the countries or provinces with a centrally determined plan for the introduction of computers in education; France, U.K., Scotland and some provinces of Canada, have been able to develop best a scheme of in-service training whereby teachers can become familiar with the use of computers as a machine, learn how to use them effectively for curriculum purposes and introduce their pupils systematically to a variety of computer applications. The introduction of effective in-service is assisted by limiting the range of equipment to be used. After careful consideration the U.K. has deliberately restricted the kind of equipment that the government will support to a few models. There is still the opportunity of a wider choice for schools, but with the limitations of higher cost and less supporting software.

3.41 In some countries or provinces the equipment has become restricted, de facto, by the thrust of commercial firms, for example Apple, which have overtaken the market through quickly manoeuvred discount offers. This is not to suggest that the Apple computer does not in many cases, provide suitable hardware for many purposes but the problem remains that the initiatives have been taken by commercial firms in advance of the educational planners, and the equipment is bought by schools and the institutions without full assessment of what they need. This has also occurred in Australia, particularly in the larger States.

3.42 A further and most important conclusion from the evidence collected is that the most effective implementation of computers in education has occurred in those countries where there has been substantial backing from government funds. The funding provided has not always guaranteed success, as with certain Canadian provinces where it might be considered that too much haste has accompanied the expenditure of large sums, necessitating a subsequent review of large scale computer projects. However, the absence of adequate funding has invariably resulted in a spate of discontinuous, diverse and inadequately planned or evaluated initiatives in computers which have sometimes added to schools' resistance to innovation and wasted considerable investments in equipment and manhours.

3.43 Even with well planned and systematic introduction of computers in education, the production, dissemination and quality control of software continues to be a substantial problem. In no country visited was the software developed to a large scale where it was generally of a high quality, well known and readily accessible as a resource for all teachers. The materials produced by teachers themselves, while valuable in a limited way, do not usually lend themselves to being an appropriate State or national resource because of problems of quality and transferability, while the costs of establishing a major software production centre, with its demands for both wideranging curriculum expertise and also programmers adaptable to the generally liberal educational philosophy of supporting locally based curriculum are prohibitive. The production and management of educational software therefore continues to be a dilemma and no country seems yet to have resolved it satisfactorily.

SUMMARY OF OVERSEAS FINDINGS

3.44 The following is a summary of overseas findings:

- China, Thailand and Yugoslavia are not sufficiently developed economically to introduce computers into education and in any case are uncertain as to the level of priority which they should give to any future introduction.

  (Paras 1.1,1.4 to 1.8,3.1)

- Japan, Germany and Sweden despite their resources, advanced educations systems and strong technological status have chosen not to introduce computers into schools for a variety of reasons relating to the nature of their society, the strongly held views about the importance of the teacher-pupil relationship and the traditional didactic nature of their teaching procedures. Of importance to us is the attitude of teachers in these countries a large majority of whom support this position.

  (Paras 1.2,1.9 to 1.23, 3.3 to 3.5)

- Acting on the belief that the need to develop large technology is fundamental for its survival, France has since 1969 been active in the field of computers in education. Of great significance are two important facts, first, the French belief that the teacher is the central factor in the success or otherwise of the use of computers in education particularly in the school; and secondly the efforts of the French government to involve private enterprise in the development of compatible hardware and quality software.

  (Paras 1.2, 1.27 to 1.43 3.6 to 3.8)

- After a somewhat confused and ragged beginning similar to the present state of development in Australia, the United Kingdom through the MEP and SMDP activities is making a more systematic attempt to introduce computers into education. Features of the Programmes are the extent of government funding, the continuing stress on all types of teacher inservice, and to a lesser extent, preservice training as essential for success, the provision of funding from the budgets of both school and work authorities, a small attempt to involve both educational and private enterprise authorities in the total programme, and a concentration on the production of software to meet curriculum needs.

  (Paras 1.44 to 1.64, 3.9 to 3.11)

- Problems in the UK Programmes which have not yet been fully overcome and which are of significance for us are the attitudes of teachers who do not wish to participate, insufficient funds to develop software libraries, shortage of suitable staff, insufficient demonstration equipment in teachers' centres and tertiary institutions offering training courses, and insufficent equipment in schools for ready hands-on experience.

  (Paras 1.55)

- Of all the committed countries, the largest investment in computers in education has been in the USA. This results from contact by the public over many decades with the microcomputer technology and when coupled with insistent sales campaigns has resulted in community pressure and assocated political support for schools to utilize these new techniques. The provision ranges from some highly sophisticated centralised and commercial programmes to a much larger provision of lower-quality materials produced by individuals and small groups. Surprisingly the larger educational publishers have not as yet brought their expertise into the field to the extent which might have been expected.

  (Paras 1.65 to 1.79, 3.2)

- In education, the Canadian provinces have strongly asserted their independence and have vigorously resisted encroachments on their educational sovereignty by the Federal Government. Accordingly, while there are some worthwhile provincial programmes, there are wide differences in the degree of development in computer education between the provinces, a lack of communication between relevant authorities, duplication of effort and underfunding of research projects. The Canadian Research Council Associate Committee in Industrial Technology has attempted a cross-province role but has been restricted by provincial assertions of educational independence and its own lack of funding. Despite these problems, the increasing use of available high technology in Alberta and Ontario for the purposes of consolidating and improving the use of computers in education has placed these provinces well ahead of Australian States.

  (Paras 1.80 to 1.98, 3.13)

- The countries or provinces with a centrally determined plan for the introduction of computers in education: France, United Kingdom, Scotland and some provinces of Canada have been able to develop best a scheme of inservice-training for teachers which assists in breaking down the negative attitude of teachers. They have also managed to achieve reasonable success in introducting students to a variety of uses of computers in education.

  (para 3.14)

- From the evidence collected it is clear that the most effective implementation of computers in education has occurred in these countries where there has been substantial backing from government funds.

  (Para 3.16)

- Even with well planned and systematic introduction of computers in education, the production, dissemination and quality control of software continues to be a substantial problem.

  (Para 3.17)

3.45 It is not proposed to summarise the descriptions of Australian activities outlined in Chapter Two. It is clear from them that Australia has committed itself to the introduction of computers into education. It has eschewed the concerns of the developed countries, Japan, Germany and Sweden who have decided at this stage not to proceed and accepted a commitment similar to that of France, the United Kingdom, USA and Canada.

3.46 The commitment to computers in education is an expensive decision the cost of which extends far beyond any expenditure on previous provision of facilities to assist learning and has already shown in other countries that it will require careful planning and cooperative effort by all involved if it is to be effective.

3.47 While Australian parents and politicians are committed to the utilization of computers in schools and educational institutions, it is uncertain whether teachers are as equally committed. This is a world-wide phenomenon and experience of countries more advanced in the utilization of computers emphasise the view that the policies and procedures laid down will ultimately determine the level of teacher acceptance and involvement and subsequently the success or otherwise of the new techology.

3.48 There is no doubt that Australia is not as advanced in any aspect of computer education policy development as the other committed countries.

3.49 Each State has developed its own strategies and policies on the use of computers in schools. Except for the Tasmanian, South Australian, Western Australian consortium the states differ in the equipment (hardware) that is used, in the range and availability of programs (software) for the equipment, in the kinds of uses to which they put computers in the courses about computers they offer and in the supporting resources of staff and funds which are provided to use the program and equipment successfully.

3.50 As far as government schools are concerned, the administrative support structures in the respective Education Departments vary from the highly centralised, resulting in considerable uniformity of equipment and support services in computers in schools to school based decision making which has produced an uncomfortable diversity.

3.51 Diversity in approach, varying degrees of departmental control and a laissez-faire attitude by most governments have created until recently areas of concern. Lack of firm guidelines and policies for the use of computers in schools

in the larger States and the active marketing policies of computerfirms has resulted in many instances of schools purchasing equipment without a clear plan for its use by all staff. The resulting incompatibility of hardware and software, within and between States is a growing problem which can be solved only if there is prompt and agreed action at the national and state levels.

3.52 It is clear that Australia is at a very early stage of developing software. Some of the available equipment and much of its associated software is not suitable for or has not been designed for schools. National cooperation for hardware specification and software development is required urgently if we are to prevent individual schools and States from making ad hoc decisions which will make cooperation more difficult and the total procedure more expensive.

3.53 The position and policy papers from the different States and the Commonwealth which have been examined indicate that committees and enquiries have been or are being established in all of them. The survey reveals that these actions should be accelerated if Australia is not to drift into expensive and ineffective utilization of the technology.

3.54 While the Directors-General of Education in the various States and Territories have been actively involved through their senior computer officers in developing avenues for the exchange of information and development of policies, it was difficult to obtain an accurate picture in the post-secondary sector. All States have reported some activity in universities, colleges of advanced education and TAFE colleges, and Victoria, South Australia and Western Australia have surveys underway but there does not apppear to be any action at the national level comparable with the Commonwealth Schools Commission National Advisory Committee on Computers in Schools. In view of the importance of these institutions in computer research and the most essential task of preservice and inservice education of teachers in the computer areas, the lack of information about proposed action is disturbing.

3.55 All States have developed some programmes for the use of computers in administration but again the utilization varies, in this instance, from instructions and assistance to schools through to large scale installations handling thousands of personnel records, building materials control and salary cards.

National and State Objectives and Procedures

Recommendation 1 — The Federal and State Governments should develop and publicize a considered rationale and clearly stated set of national and state objectives for the use of computers in education at all levels, utilizing the findings from both the Commonwealth Schools Commission National Advisory Committee on Computers in Schools and the enquiry recommended below for the tertiary institutions. (See Recommendation 14)

Recommendation 2 — As successful programmes for computers in education have invariably been those backed by substantial long term government funding, Federal and State Governments should develop and announce, at the same time as the agreed set of objectives are released, a financial package covering at least a three year period.

Recommendation 3 — Steps should be taken to involve the commercial entrepreneurs in policy development in education, with the expectation that their finance and expertise will be available in hardware and software and teacher training on a useful and cooperative basis.

Recommendation 4 — In the allocation of funds a planned proportion should be allocated to hardware and the preparation of software, but the largest proportion and first priority should be for the preservice and inservice education of teachers.

Recommendation 5 — An examination should be made at the national/state level of the feasibility of producing specifications for computer equipment based on minimum standards which would allow a restricted range of models to be used and the eventual development of locally made computer systems and software with a committed market in some or all of the states.

Recommendation 6 — A National Clearing House for Computer Information should be established to facilitate the interchange of hardware and software information between states and the cooperative development of appropriate high quality software.

Recommendation 7 — Cooperative mechanisms should be established at the national and state levels for ongoing evaluation and review of all aspects of the use of computers in educational institutions and programmes of teacher preparation, including an assessment of the development of positive attitudes among teachers.

Schools

Recommendation 8 — Computers should be introduced into primary and secondary schools, but on the basis of previously locally determined and understood educational purposes and not because of the availability of local funds or discounted equipment.

Recommendation 9 — For a substantial initial period the kinds of equipment available to schools on government subsidy should be restricted to permit rapid development of appropriate teacher training, educationally sound software and adequate back-up and maintenance services.

Recommendation 10 — Because of the shortage of specialists, software developed in each state should, in the first instance, be done through centrally or regionally established teams of curriculum specialists , programmers and educational technologists.

Recommendation 11 — For the next few years, educational use of computers should have priority over the administrative use of computers in schools. Although computer awareness courses might be developed at primary school level and courses or electives in computer science at higher secondary level, the focus for the investment of funds and development of hardware and software should be on the compulsory years of the junior secondary school.

Recommendation 12 Each state should establish an Education and Industry body to monitor changes in the workforce due to the increasing use of technology and to support modifications in the educational goals for computers in education to keep abreast of these changes.

Recommendation 13 Special education should be given a priority in funding because of the unique potential of computer equipment to assist learning for students with mental or physical disabilities.

Tertiary Institutions

Recommendation 14 The Tertiary Education Commission, its Councils and State Coordinating Councils should establish a procedure for a survey of the utilization of computers in post-secondary institutions with the aim of improving computer research, rationalising the provision of courses in computer science and making provision for the urgently required preservice and inservice training of teachers in this field.

Recommendation 15 In tertiary institutions pre-service teacher education on the use of computers in education should be based on the needs of schools, and developed after a clear statement of educational goals has been prepared. Generalist trainee teachers should not all be required to learn programming, and the main focus of their computer education should be on the uses and limitations of computers with CAI/CAL and computers in the curriculum.

Recommendation 16 An investigation should be undertaken of the cost, efficiency and acceptability of the chain reaction model of teacher training. This involves in-depth preparation by tertiary institutions of specialists who in turn prepare school-based consultants, who with a team approach in schools, develop appropriate computer programmes for students.

Recommendation 17 Tertiary institutions should develop close links with industry for a more mutually supportive and economic use of resources. Research by institutions into computer technology for industry, and enhanced support services and software from industry should be encouraged.

Recommendation 18 Distance education should be given special consideration in the development of the uses for computers in education.

Recommendation 19 The development of TAFE courses with a vocational orientation in the computer area should be encouraged and augmented by providing ready transition from TAFE studies to higher education in computers.

Recommendation 20 Specialist courses in information science and computer science at tertiary level should be linked with course offerings at the senior secondary level to reduce overlap, repitition, and waste of resources.

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